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Monterey, California

# THESIS

THE AIR COMBAT EFFECTIVE PILOT: AN ANALYSIS OF THE PERSONAL CHARACTERISTICS AND COMBAT SKILLS OF KOREAN FIGHTER PILOTS

by

Sang Gil Lee

June 1986

Thesis Co-Advisors: Thomas G. Swenson
Mark H. Lepick

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# The Air Combat Effective Pilot : An Analysis of the Personal Characteristics and Combat Skills of Korean Fighter Pilots

by

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Submitted in partial fulfillment of the requirements for the degree of

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from the

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June 1986

ABSTRACT

Recognizing the tenuous position that the Republic of Korea maintains with regard to communist North Korea, the Korean Air Force, as a first line of defense, must maintain the highest level of air combat readiness, the crux of which is the combat effectiveness of its pilots. Through research of past studies, the determinants of the combat effective pilot, combat skills and psychological characteristics, were identified and broken down into component factors, which have positive effect on combat effectiveness and implications for pilot selection, training, and assignment. NPS Korean Air Force students were surveyed as to their perceptions of these factors as they relate to combat effectiveness and their own experience. This activity served as a primitive model for possible expert systems determination of improved objectives in support of Korean Air Force combat effectiveness training.

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# I. INTRODUCTION

Today, the significance of air combat readiness for national defense is more critical than ever before, as air forces become more modern and powerful. The latest wars; the Lebanese conflict, the Falkland war, the Iran/Iraq war, and the USA/Libya conflict have each shown its critical significance. The result is each country trying to increase its air combat readiness level through additional combat pilots, state-of-the-art aircraft, sophisticated weapon systems, early warning systems, and electronic warfare systems, etc. However, it is impossible to acquire all to the levels desired because of the many economic, technological, and human resource constraints. Accordingly, a country must find the most efficient and effective way to increase total air combat readiness level in keeping with those constraints.

The best way to achieve increased air power may be to secure more combat effective pilots, since they are the operators of all other systems. A failure to secure those combat effective pilots may make other enhancement efforts meaningless.

The issue of increasing air combat readiness is particularly significant to the Korean Air Force (KAF) because the KAF is inferior in size to the Air Force of communist North Korea. The securing of more combat effective pilots for increased air combat readiness may be the most urgent issue in KAF, under the assumption that pilot quality control will be able to overcome inferiority in numbers.

The critical significance of an air combat readiness for Korean national defense, the value of the combat effective pilot, and measures for the pilot quality in the KAF as brought out by a profile of the combat effective pilot are

the main focus of this thesis. Specifically, NPS Korean pilots sample data will be used to demonstrate a quality difference among these pilots and to suggest research possibilities for assessing potentially combat effective pilots based on their psychological characteristics and special combat skills, as introduced in the McDonnell research team's final report (1977). The McDonnell team's report will be referenced heavily in determining an effective pilot's profile and its supporting criteria.

Although the populace expects victory in case of war, even when their forces are inferior, desire does not assure victory. There is no substitute for an active, in place, effective force in times of hostility. This research will attempt to provide a step toward increasing air combat readiness of the KAF, and promoting further KAF research activities in the quest for maximum air combat effectiveness. Revisiting this area with a larger and more controlled sample of KAF pilot data could prove valuable in the study of pilot quality in the KAF, particularly when considered in light of different social backgrounds, military systems, and environmental situations.

# II. AIR COMBAT READINESS

## A. THE SIGNIFICANCE OF AIR POWER

### 1. The Role of an Air Force

> The challenges that face you in your career in the Air Force are infinite. We have entered an era where horizons are, for all intents and purposes, unlimited; where the pace is unbelievably fast and increasing; where the threat which we must meet is daily growing....

The above quotation is a part of General Lemay's address on the occasion of the Third Annual Wright Memorial lecture concerning the future of the U.S. Air Force [Ref. 1: p. 216], and shows the increasing role of Air Forces in general.

Within three days after the Japanese directed a crippling air attack on U.S. fleet at Pearl Harbor in 1941, the two most powerful ships in the Royal NAVY's Far Eastern Fleet, "Repulse" and "Prince of Wales", had been sunk by Japanese Torpedo bombers once they sailed beyond the range of protective air cover. At that time, certain incredulous western observers insisted that it had been done by German pilots who had flown a special mission [Ref. 2: p. 85]. That is, they tried to analyze this event from the view of the special pilot's ability rather than the significance of Air Power. They firmly believed that absolute Sea Power remained with fleets. The relevant meaning of this event was the emergence of a new decisive power in the war.

During World War Two, Japanese war planes blackened the skies from China to Mongolia, from Australia to Philippines, from Hawaii to Alaska, from Malaya to Burma, India, and Ceylon. But Japanese military expansion was soon stopped when they engaged the Air Power of the United States. One could predict the result of the war by looking at the data of Table I.

TABLE I

AIRCRAFT PRODUCED IN 1941-1945

| YEAR | JAPAN | U.S.A |
|---|---|---|
| 1941 | 5,088 | 19,433 |
| 1944 | 28,180 | 100,752 |
| 1942-1945 | 58,882 | 261,826 |

* Source: Adapted from "Air Power and Warfare" 91p, Proceedings of the 8th Military History Symposium USAF Academy, Oct 1978.

Finally, the Japanese realized the significance of Air Power at their expense.

Air power has assumed a critical role in present warfare from the auxiliary role it played for the Army and Navy at the beginning of World War Two, increasing as its systems have grown in capability.

Once US Air Power was neutralized by the cease fire in 1973, the North Vietnamese eventually moved their units openly and rapidly into South Vietnam. Following President Ford's rejection of President Thieu's direct request for the return of American Air Power, communist unification of Vietnam took place within a short time. Ray L. Bowers, a retired Air Force colonel, stated that only a massive U.S. Air intervention, at least on the scale of 1972, could have saved South Vietnam. His comment supports the assertion that the U.S. Air Force did not just waste fuel and ammunition during operations in Vietnam, as many strategists point out [Ref. 2: p. 324].

The increased role of Air Power has been shown more recently in the Middle East war. The role of the Israeli Air Force in the Arab-Israeli war is a representative model. Its superiority was demonstrated in the limited battles with the Egyptian Air Force in 1956, and in the destruction of the Egyptian, Jordanian, and Syrian Air Forces in 1967, and in the absolute supremacy in aerial combat achieved against

Egypt and Syria in 1973. Since 1978, dogfights between Syrian and Israeli aircraft over Lebanon have invariably ended in the downing of the Syrian planes. In 1982, 90 Syrian planes were shot down as opposed to two Israeli planes, both downed by anti-aircraft defenses [Ref. 3: p. 283]. This record is the most plausible reason for Israel's survival.

During the 10-week confrontation between Britain and Argentina in 1982, the world attention focused on the conflict to see what lessons could be learned. Had they bought the right equipment for their own services, and would they be able to use it efficiently and effectively if they encountered a similar crisis? The Falkland war showed the significance of Air Power again. The activity of the Harrier, Britain's v/stol aircraft, was a highlight of the Falkland war victory. Reginald Turnill said that without these unique aircraft, it is certain that the Defense Staff would never have agreed to the task force being sent to the Falklands (Britain could not have expected victory) [Ref. 4: p. 26]. Air Power had the same meaning for Argentina as well. Although they lost the war, their Air Force sufficiently demonstrated the power of a modern Air Force. Specifically, the World was surprised when Argentinian aircraft sank the Britain's H.M.S.[1] Sheffield which was equiped with a modern air defense system.

Today, it is not the time of the Ground or Sea conqueror, but the time of the Air conqueror. Air Forces will take a decisive role in future war because of its characteristics (rapidity, flexibility, fire power, mobility, etc).

---

[1]H.M.S. - His/Her Majesty's ship.

Sir Winston Churchill expressed his thoughts about the role of Air Power with brevity and clarity after World War Two [Ref. 1: p. 91].

> Air mastery is today the supreme expression of Military power. Fleets and Armies, however necessary, must accept a subordinate rank.

2. <u>Air Power of Selected Countries</u>

S.L.A. Marshall, retired Brigadier General, USA, said that Military systems advance most easily and at lowest cost by watching well what others do somewhat better [Ref. 5: p. 28]. So, observing others is an appropriate starting point for the endeavour to look upon our current position and to improve our air combat readiness.

As Churchill foretold, the new decisive role of Air Power has manifested itself since World War Two. Now, most countries are trying to expand and modernize their Air Forces, and this trend will not change unless they believe they enjoy superiority of air power in a war.

a. Israel Case

The Israeli Air Force has always enjoyed highest priority in the development of Israel's military power. This priority stems in part from the fact that most of the IDF is a militia army. Israeli Air Power is built largely on standing forces and on a high state of alert, meant to compensate for the shortage of regular ground forces and to provide protection while reserve units are mobilized and deployed for battle. The IAF, as a central component of Israel's military power, has traditionally been allocated a large share of Israel's financial resources and sophisticated manpower [Ref. 3: p. 284]. Consequently, they have focused on getting higher quality aircraft and people instead of focusing on quantity and have one of the world's most modern and capable Air Forces.

b. Arab Countries

Table II shows the major Air Forces of the Middle East.

TABLE II

MAJOR AIR FORCE OF THE MIDDLE EAST

| Country | | Personnel (thousands) Reg/Res | Tot | Intercepters High Qual' | Others | Strike & Multi role a/c High Qual' | Others | Total combat a/c |
|---|---|---|---|---|---|---|---|---|
| Egypt | 1983 | 110/25 | 135 | - | 280 | 132 | 180 | 612 |
| | 1984 | 110/25 | 135 | - | 310 | 190 | 120 | 635 |
| Iran | 1983 | 35/- | 35 | 70 | - | + | 80 | 150 |
| | 1984 | 35/- | 35 | 10 | - | + | 70 | 80 |
| Iraq | 1983 | 40/- | 40 | 25 | 200 | 185 | 60 | 500 |
| | 1984 | 40/- | 40 | 25 | 200 | 195 | 95 | 532 |
| Israel | 1983 | 30/50 | 80 | 40 | - | 445 | 185 | 670 |
| | 1984 | 30/50 | 80 | 40 | - | 415 | 185 | 640 |
| Libya | 1983 | 7/- | 7 | 60 | 75 | 275 | 10 | 470 |
| | 1984 | 9/- | 9 | 60 | 75 | 315 | 40 | 510 |
| Syria | 1983 | 70/38 | 108 | 50 | 280 | 160 | 110 | 600 |
| | 1984 | 90/38 | 128 | 50 | 310 | 190 | 100 | 650 |
| Saudi Arabia | 1983 | 15/- | 15 | 20 | 35 | - | 95 | 150 |
| | 1984 | 15/- | 15 | 60 | 35 | - | 110 | 205 |

* Source: Mark Heller, "The Middle East Military Balance", 1984.
REF: "+" indicates a precise number unknown
"-" indicates no entry.

Arab Air Forces have not been able to achieve air superiority, nor have they played a significant role in the ground battles. Nevertheless, they have powerful Air Forces and have been trying to modernize continuously. Syria, Egypt, and Libya are aware that, in order to decide the land battle, a massive participation by the Air Force is necessary, despite the fact they had not achieved victory in past Middle East wars. So, a large number of advanced aircraft (MIG-23, MIG-25, SUKOI-20, SUKOI-22, etc) have been acquired recently [Ref. 3: p. 234]. Generally, most of the Arab countries (except Iran) are trying to expand, and modernize their Air Forces, suggesting that in a future war,

Arab Air Forces may attempt to play a much larger role than they have before.

c. Iran/Iraq case

The status of the Iranian Air Force within the last 8 years is shown in Table III.

TABLE III

THE STATUS OF IRANIAN AIR FORCE 1978-1985

| Year | Personnel | Combat A/C |
|---|---|---|
| 1978 | 100,000 | 459 (56:F-14/177:F-4E included) |
| 1979 | 100,000 | 447 (77:F-14/190:F-4D,E " ) |
| 1980 | 70,000 | 445 (77:F-14/188:F-4D,E " ) |
| 1981 | 35,000 | 100 (serviceable?) |
| 1982 | 35,000 | 90 (serviceable?) |
| 1983 | 35,000 | 70 (serviceable?) |
| 1984 | 35,000 | 95 (serviceable?) |
| 1985 | 35,000 | 80 (serviceable?) |

* Source: Adapted from "The Military Balance", 1979-1985, The international institute for strategic studies.

One can see a significant decline of the Iranian Air Force since 1980. Following the fall of the Shah, Iran did little for their Air Force except drive out many senior officers and pilots, and, as a result, the size of the Iranian Air Force declined over 50 percent. The Iranian Air Force has been so decimated that it can no longer play a significant role in the Iran-Iraq war (1980-Present). A level has been reached where F-14s, one of the most capable intercepters, have been converted to a primarily air borne radar role, with no interception capability [Ref. 3: p. 313].

In contrast, The Iraqi Air Force has assumed an increasing important role in the Iran-Iraq war with its retained Air Power [Ref. 6: p. 262]. Its role has become particularly critical for defense after Iranian's offensive ground attack began in 1982. Iraqi Air Force should improve with a national concern for it as the most powerful defense.

d. USA and Soviet Case

Expansion of American Air power began in Jan 1939 with President Roosevelt's direct request[2] for expansion of Air Power, and Congressional authorization of a three fold expansion of the Air corps just before World War Two (Table IV).

TABLE IV

U.S. ARMY AIR CORPS EXPANSION AUTHORIZATION (1939)

| | Aircrafts | Officers | Enlisted Men |
|---|---|---|---|
| Before Request(1939) | 1700 | 1600 | 18,000 |
| Authorized(1939) | 5500 | 3203 | 45,000 |

* Source: Adapted from "Air Power and Warfare" 75p, 1978.

This expansion of the Air Corps foretold of America's definite air superiority during World War Two. But, the situation has changed recently. At present time, the United States is inferior to the Soviet Union in absolute terms of the size of Air Force and the number of aircraft. The Soviets produce and deploy systems in great quantity for themselves, customers and allies. They have been building, on average, over 1,200 fighters per year for the past five years [Ref. 7: p. 46], and this number might influence the Air Force of the communist block countries and some Arab countries, since Soviets are the major arms merchant in the Third world (Table V).

The USA has negated the numeric inferiority by the higher quality (aircraft, weapon systems, electronic warfare systems, etc.) and this approach has been proven in the recent Lebanon War (1982). But, this challenge becomes more difficult as the sophistication of Soviet weapon

[2] "our existing forces are so utterly inadequate that they must be immediately strengthened", The State of the Union message to Congress.

TABLE V

ARMS DELIVERIES TO DEVELOPING COUNTRIES(%), 1979-1983

| ITEM | USSR | USA |
|---|---|---|
| Anti-Air Artillery | 39 | 3 |
| Supersonic combat a/c | 56 | 14 |
| Subsonic combat a/c | 33 | 31 |
| Other fixed-wing a/c | 17 | 5 |
| Helicopters | 50 | 9 |
| Surface-to-Air missile | 57 | 23 |

* Source: Adapted from "World Military Expenditures and Arms Transfer", U.S. Arms Control and Disarmament Agency, 1985.

systems and aircraft capabilities grow. For example, sophisticated aircraft like the SU-27 Flanker and MIG-29 Fulcrum, which are equivalent to the F-15 and F-16, are currently being introduced; both possessing advanced weapon systems-modern radar, missiles that can attack from any aspect, and sophisticated electronic-warfare systems [Ref. 7: p. 46]. We can see from the Appendix A that the USAF is trying to increase both the quantity and quality of its Forces to correspond with the Soviet's expansion and modernization.

e. Conclusion

Table VI presents the strength of several national air forces and the sizes. It indicates that most of the countries have Air Forces which represent over 10% of their total military forces. T. R. Milton, retired general, USAF, mentioned the special priority of Air Power of the Arabs, Israelis, and Chinese, all of whom anticipate being involved in a war [Ref. 2: p. 308].

Because of wartime experience and Air Power's growing capability, most countries consider it the most

TABLE VI

WORLD'S NATIONAL AIR FORCE SIZE

| COUNTRY | ITEMS | COUNTRY | ITEMS |
|---|---|---|---|
| U.S. : | GDP(1984)= $3619.2 bn<br>DEF( " )= $258.2 bn<br>TOTAL REG'= 2,151,568<br>AIR FORCE = 603,898<br>& 3700 a/c | USSR: | *GNP(1984)=$1672-1920 bn<br>*DEF( " )= $295 bn<br>TOTAL REG'= 5,300,000<br>AIR FORCE = 570,000<br>& 5900 a/c |
| JAPAN: | GDP(1983)=$1,983 bn<br>DEF(1984)=$12.02 bn<br>TOTAL REG'= 243,000<br>AIR FORCE = 44,000<br>& 270 a/c | CHINA: | *GNP(1984)= $309-362 bn<br>DEF( " )= $7.8 bn<br>TOTAL REG'= 3,900,000<br>AIR FORCE = 490,000<br>& 5300 a/c |
| ISRAEL: | GDP(1984)=$23.34 bn<br>*DEF( " )=$5.8 bn<br>TOTAL REG'= 142,000<br>AIR FORCE = 28,000<br>& 684 a/c | EGYPT: | *GDP(1983)= $33.66 bn<br>*DEF(1984)=$3.78 bn<br>TOTAL REG'= 445,000<br>AIR FORCE = 25,000<br>& 427 a/c |
| LIBYA : | GDP(1982)=$29.86 bn<br>*DEF( " )=$0.709 bn<br>TOTAL REG'= 74,000<br>AIR FORCE = 8,500<br>& 535 a/c | SYRIA: | GDP(1983)=$19.745 bn<br>DEF(1984)= $3.21 bn<br>TOTAL REG'= 402,500<br>AIR FORCE = 70,000<br>& 500 a/c |
| IRAN : | GDP(1983)=$122.69 bn<br>*DEF(1984)=$20.16 bn<br>TOTAL REG'= 305,000<br>AIR FORCE = 35,000<br>& 80 a/c* | IRAQ : | *GDP(1983)=$30.556 bn<br>*DEF(1984)=$13.83 bn<br>TOTAL REG'= 520,000<br>AIR FORCE = 40,000<br>& 500 a/c |
| KOREA : | GDP(1984)=$83.22 bn<br>DEF( " )= $4.49 bn<br>TOTAL REG'= 598,000<br>AIR FORCE = 33,000<br>& 451 a/c | NORTH KOREA : | *GDP(1984)=$39.97 bn<br>*DEF( " )=$4.086 bn<br>TOTAL REG'= 838,000<br>AIR FORCE = 53,000<br>& 800 a/c |
| TWIAN : | GDP(1984)=$56.06 bn<br>DEF( " )=$3.417 bn<br>TOTAL REG'= 444,000<br>AIR FORCE = 77,000<br>& 567 a/c | ENGLAND: | GDP(1984)=$400.04 bn<br>DEF( " )=$21.4 bn<br>TOTAL REG'= 327,100<br>AIR FORCE = 935,600<br>& 599 a/c |

O Source: Adapted from "The Military Balance 1984-1985", The International Institute Strategic Studies.
O REF: * indicates an estimate value.
: USSR AND EGYPT AF' does not include Air Defense Force.
: The # of a/c is the number of combat aircraft.

decisive implement of the warfare. Major General Lauris Norstad's writing about the postwar Air Force in 1945 expresses clearly a prudent attitude toward standing Air Forces [Ref. 2: p. 216].

Due to training specialization required and increased production problems of technical equipment, we must have

> sufficient strength in trained personnel and modern equipment to engage an enemy without being allowed time to build up an Air Force. In the last two wars we have fortunately been afforded up to two years to gear for war. With the character of modern warfare changed so radically in this last war, particularly by new weapons, in the next war we will be in the midst of an all-out war from the start. Our only salvation will be in immediately available modern weapons with sufficient personnel adequately trained in their use

## B. AIR COMBAT READINESS MODEL

Having above considered the role of the modern Air Force and each country's apparent desire for Air Power, the next task is to determine an appropriate analytical approach to developing a combat readiness model. Air Combat Readiness presents a composite picture of Air Power, since it is not only a function of absolute size of Air Forces, but a function of all relevant factors contributing to Air Power. There is a clear difference between the degree of Air Combat Readiness and the size of the Forces, such that one can not estimate the level of Air Combat Readiness by merely counting the number of aircraft or number of billets. In a hierarchical sense [Ref. 8: p. 4],

(1) Air Combat Readiness is a function of total system combat effectiveness.

(2) Total system combat effectiveness is a function of a sub system combat effectiveness

(3) Sub system combat effectiveness is a function of sub system output.

(4) Sub system output is a function of sub system elements and attributes.

Therefore, one can construct a model of Air Combat Readiness by using sub-system elements and attributes, and we can assume all sub-system elements and attributes have a positive effect on the attainment of Air Combat Readiness.

An Air Combat Readiness model can be expressed as the following mathematical function.

$$W = F ( f ( f' ( f'' ( p, w, a, e, r, m, \ldots\ldots ) ) ) )$$

where W = the level of Air Combat Readiness

F = a certain function

f, f', f" = sub-functions

p = pilot's ability

w = weapon system capability

a = aircraft capability

e = electronic system capability

r = radar(early warning and intercept) system capability

m = maintenance ability

etc.

This expression indicates that an air combat readiness level will be determined by pilot's ability, aircraft capability, and weapon systems, etc. To enhance or improve on the measures of any of the factors is to increase total Air Combat Readiness.

The need for maximum Air Combat Readiness is more pressing than ever before in terms of its potential influence in wartime. However, readiness goals can not continue to be achieved through budget, hardware, and manpower alone because of constraining economic and demographic factors. These goals are, nevertheless, the absolute requirement for victory. Therefore, we must find the best method to measure and increase the level of Air Combat Readiness efficiently and effectively.

Our focus will be made on a 'pilot ability' among those relevant sub-factors, as the pilot draws all other factors together in order to attain the desired level of performance and readiness. A pilot's ability will be the most crucial factor of air combat readiness unless all aircraft are

configured as Remote Pilot Vehicles (RPV). A detailed discussion of the correlation of combat pilot and air combat readiness will be presented in the next section.

## C. THE SIGNIFICANCE OF THE COMBAT PILOT TO AIR COMBAT READINESS

### 1. Theoretical Research

In 1984, Mr. R. Blankert and CAPT N. Powel presented an analysis of aircraft/weapon/pilot performance related to Air superiority, in an effort to determine which factor had the greatest effect on performance.[3] The following two conclusions [Ref. 10: pp. 35, 43] emerged from a case analysis:

1. Case 1 (fix two variables with medium values, change one variable) analysis:
   - Most effect seen with changes in pilots, next with weapons, and least with aircraft.
   - Aircraft performance parameters had little effect.
   - If RED deploys average pilot or average weapons, BLUE probability of survival is not sufficient.
2. Case 2 (fix one BLUE variable with medium value and change other variables, with fix all RED variables at medium values) analysis:
   - The difference between good and poor pilots is accentuated by better weapons and aircraft.
   - The combination of the best weapon and the best pilot produced the highest Ps and largest K; Ps means a probability of survival, K means the expected number of kills.
   - Aircraft performance does not seem to significantly influence result.
   - Weapon performance and aircraft performance do not influence each other.
   - Most performance improvement is provided by improvement in the pilot.

One can see the most important factor is "the combat pilot" among the factors relevant to Air superiority which in turn can serve as a measure of Air Combat Readiness.

---

[3]They applied three factors (aircraft, weapon systems, and pilot) into an imaginative air combat between RED and BLUE side.

A similar kind of analysis has been introduced also, in Chaput's analysis of the past four representative air battles (Table VII).

TABLE VII

AIR COMBAT WIN-LOSS CORRELATIONS

| | WINNER | | | | LOSER | | | |
|---|---|---|---|---|---|---|---|---|
| | MOST DECISIVE | | LEAST DECISIVE | | MOST DECISIVE | | LEAST DECISIVE | |
| Relevant Factors | Leb' war ISR | Yom Kippur ISR | Kor' war U.S | Viet' war U.S | Leb' war SYR | Yom' Kippur EGY/SYR | Kor' war NKOR | Viet' war NVN |
| Loss exchange rate | 80+ kills | 21:1 | 10.6:1 | 2.6:1 | NO | 1:21 | 1:10.6 | 1:2.6 |
| Superior pilot skills | YES | YES | YES | YES | NO | NO | NO | NO |
| Weapon effect- iveness | YES | YES | YES | MARGIN- INAL | NO | NO | NO | NO |
| Aggressive tactics | YES | YES | YES | NO | NO | YES | NO | NO |
| Situation awareness | YES | YES | YES | FAIR | YES | YES | YES | YES |
| performance superiority | YES | NO | NO | NO | NO | YES | YES | YES |
| Numerical superiority | NO | NO | NO | YES | YES | YES | YES | NO |

* Source : Armand J. Chaput, "History Benefits Next Generation Fighter Design", Aerospace America, May 1984.

Analysis of these encounters has identified winning and losing factors that may bear on the future, and indicate that superior pilot skill correlates with "Winner" in Table VII. Although the other factors such as weapon system, aircraft capability, tactics, and numerical superiority are important as well, Chaput's analysis has confirmed the critical significance of pilots' ability in air combat. Concerning the 1982 Lebanon Bekka Valley air campaign between Israel and Syria, Chaput states [Ref. 9: p. 49].

> Clearly, the technical capability of those air planes (F-15, F-16) were a factor in the rout, but the Israelis probably would have won without such superior machines.

2. <u>The Significance of a Combat Pilot's Ability</u>

The unbelievable performance of the IAF highlights the contribution of combat pilot to Air Combat Readiness and wartime Air superiority. A closer look at the IAF combat pilot performance versus that of other countries is instructive.

As a representative example, consider Iraqi combat pilot performance in the initial Iran-Iraq war. The Iraqi offensive against Iran began with a massive strike by most of the Iraqi Air Force in 1980. It was designed to destroy the Iranian Air Force at its bases, and was modeled after the Israeli destruction[4] of most of the Egyptian Air Force on June 5, 1967. Iraq expected to get results similar to those achieved by the Israelis, but failed except with respect to a their successful penetration. Besides the insufficient sorties assigned each target, many bombs did not explode upon impact, apparently because they were released improperly, at too low an altitude. In a word, they lost their decisive advantage of surprise due to the lack of pilot skill [Ref. 3: p. 312].

One may try to explain the differences in outcome in terms of differences in aircraft capability, weapon systems, and intelligence systems, etc, but would be unable to explain so big difference in performances without a consideration of combat pilot ability. After the Lebanon Bekka Valley Battle (1982), one Israel fighter pilot commented about the Syrian pilot [Ref. 11: p. 9],

> they could have flown the best fighter in the world, but if they flew it the way they were flying, we would have shot them down in exactly same way.

[4] IAF's achievement for the first two days: 309 Egyptian aircraft, includes 95 MIG-21 and 30 TU-16 was cited at <u>ARAB-ISRAELI WAR</u>, Edgar O'Balance, 1972.

We do not know precisely what way they were flying. However, we can assume there was a clear difference in combat pilot ability between IAF and Syrian Air Forces. Syrian pilots might have entered into the air battle arena without knowing what to do next, even though they might have had strong confidence of a victory.

These examples emphasize that the combat pilot's ability is the most critical factor influencing the level of Air Combat Readiness as it manifests itself through victory in air operations. Former USAF Chief of Staff, General John P. McConnel's thinking supports this conclusion [Ref. 12: p. 64],

> In my opinion, success in battle will never depend solely on numbers of men or power of weapons, regardless of the dimension of the war--whether it be a limited war within the confines of a small country like Vietnam or an unlimited war fought on a global battle field. Ultimately, all weapons come under the control of men, and the knowledge, determination, and courage of those men will govern how well those weapons will be used.

The combat pilot, especially the effective combat pilot is our primary study focus, as we seek to achieve Air Combat Readiness, efficiently and effectively, recognizing the constraints placed on other factors.

Constructing a profile of the combat effective pilot as it might apply to pilot quality control is the subject of Chapter III.

# III. THE COMBAT EFFECTIVE PILOT

## A. THE PERFORMANCE OF AN AIR COMBAT EFFECTIVE PILOT

### 1. The General Combat Pilot

Most pilots, especially combat pilots, have a high degree of self-confidence and pride with respect to their particular job, and they know inately that the success of a mission will depend upon their knowledge, skill, judgement, courage, etc. Completion of the long training period and the cost of such training is of itself sufficient cause for pride. For example, the USAF determined that it will require more than 2 years and $ 1,020,000 to train an F-15 pilot to become combat ready, and this figure accounts for only the cost and time required to attain an initial qualification [Ref. 13: p. 29]. In recognizing and promoting the special pride, the Korean Air Force issues red mufflers for pilots while the other officers and enlisted men are issued blue mufflers.

In addition to their special pride, each pilot thinks he may be one of his country's best pilots, and that he can be an Ace (an exceptionally successful air combat effective pilot). It may be very desirable for pilots to have a such confidence and desire to be an ace. We can not assume that all pilots are combat effective pilots and can not be satisfied with expectations, since the value of each combat pilot is not measured in exhibitions in peace time but during actual fighting in the war. The full abilities of each combat pilot may be shown only in victory through actual air combat.

In the Israeli-Syrian experience, although there were many combat pilots, each with his special pride, every pilot could not be an Ace, and at worst case, might become a statistic in the opposite side Ace's kill record. For

example, Syrian pilots who had suffered humiliation through the past wars had been considered, generally, as lower quality pilots. But, there were few Syrian pilots who tried to avoid combat, and they showed perseverance and confidence in the past Middle East wars despite their lower level of the combat capability [Ref. 3: p. 233]. They might have even expected victory and the possibility of becoming an ace in confrontations with Israeli aircraft, but the results were to the contrary. In a word, they were not the combat effective pilots they expected to be.

In conclusion, there is a clear difference in quality among pilots. One can not say the pilot's pride or confidence will decide the pilot's performance directly, though it can be an important factor in the air battle. Instead, we should realize that some combat effective pilots exist among pilots, and some other pilots, average pilots and even non-combat effective pilots exist, as well, while nonetheless, most combat pilots consider themselves as potential Aces.

Let us consider the performance of effective combat pilots.

2. Historical Pilot Combat Effectiveness

Although each pilot wants to be a combat effective pilot, only a small percentage of pilots have been effective in past wars. The performance of this limited group is valuable to observ in terms of the expectations of this research for the combat effective pilot's selection, and training.

According to the official Eight Air Force records of 5,000 fighter pilots, only 261 (i.e., 5.2 percent) became Aces in the war against the Germans during 1943-1945. This small group of pilots, however, accounted for 40 percent of the total 5284.5 German planes destroyed by the Eighth Air Force fighter pilots. Thus, five percent claimed forty

percent of the kill. As an another example, USAF combat Super Sabre pilots destroyed 792 MIG-15 fighters while losing 78 F-86 Super Sabres in the Korean War (1950-1953). One can get a similar figure with the performance of the Eight Air Force Aces. We consider that a fair chance for a kill is a function of sufficient encounters and many pilots do not have ample opportunity to demonstrate their skill because of the characteristics of a limited modern air battle. Of the 800 USAF F-86 pilots, each of whom had at least 25 counter air missions (presumably, a fair chance for a kill), only 4.8 percent became Aces, but they accounted for over 38 percent of the total kills [Ref. 14: p. 3-8].

One can see that victory of the air battle has depended upon a small group of pilots, so called combat effective pilots. History has frequently been made by a small elite group, not by all people. The results of this analysis prompt us to seek the combat effective pilot as a means of maintaining the greatest capability for conducting an air battle.

If we select and train combat effective pilots, we can expect a higher performance and higher rate of survivability. The organization of Israel's special air combat 'Hunter' squadron, which includes their most skillful and experienced pilots, may be based on the result of this kind of analysis. The IAF sends pilots of the 'Hunter' squadron as the first wave when hostilities break out, an operating procedure which may, in addition to the superiority of general combat pilots, aircraft, and other systems [Ref. 15: p. 287], help account for the IAF's unbelievable kill ratio. In the Yom-Kippur War (1973), the Egyptian Air Force exercised their Air defense system successfully, shooting down many Israeli planes in the first few days of the war. At the time, they were quite satisfied with their achievement since they apparently eliminated some

of Israel's best pilots in addition to the actual number of aircraft downed. Although the Egyptians were unable to achieve victory in later air battles because of their continuing relative quality inferiority vis-a-vis the Israelis, one might see how the presence of the IAF's 'Hunter' squadron was recognized and appreciated by the Egyptians.

3. Background Studies

A study of the performance of combat effective pilots was conducted by H. Weiss in 1966. Weiss developed a model to estimate the impact of being able to send only "hawks" (i.e., combat effective pilot; potential Aces) to battle. Several assumptions were made - pilots can be categorized as either Hawks or Doves; Hawks, not identifiable before combat, represent ten percent of replacement pilots; Hawks always win against Doves, Hawks are equivalent, and no loss results from combat between Doves; aircraft and pilots are replaced as they are lost and forces are equal; and pilots can survive aircraft losses with a certain specified probability; Air combat engagements are one-on-one; the probability of having Hawks, Doves, or both, in each combat engagement is proportional to their representation in the two forces. Based upon these assumptions, Weiss concluded [Ref. 16]:

> If the precombat training and screening process delivers only 'Hawks' to one side, that side may have a 10:1 sustained exchange ratio, at all times.

Another study of pilot performance was performed by the McDonnell research team in 1977. They obtained performance data on 12 pilots simulating flying a fighter type aircraft using the most recent on-line gun and missile program on the NASA Differential Maneuvering Simulator (DMS).

TABLE VIII

RELATIVE PERFORMANCE BY KILL/LOSS RANKING

| PILOT | AVERAGE KILLS | AVERAGE LOSSES |
|---|---|---|
| A | 3.5 | 0.0 |
| B | 3.5 | 0.5 |
| C | 2.5 | 1.0 |
| D | 2.0 | 0.0 |
| E | 1.5 | 0.5 |
| F | 1.5 | 2.0 |
| G | 1.5 | 3.0 |
| H | 1.0 | 2.0 |
| I | 0.5 | 2.0 |
| J | 0.5 | 2.0 |
| K | 0.5 | 4.0 |
| L | 0.0 | 1.5 |

From Table VIII, one can say two of twelve pilots are clearly superior, and four of twelve are poor risks. Based on this simple simulation exercise, about 18 % of the pilot population could be selected as superior in Air Combat Maneuvering (ACM) and 25 % as inferior. A comparison of pilot A and K's performance can give us an indication why one should try to secure combat effective pilots [Ref. 14: p. 6-17]. Although, one can think of many other relevant compensate factors (e.g., flying hours, experience, weapon systems, aircraft type experience), for some inferior pilots nothing would compensate adequately.

From the Weiss and McDonnell studies, one can conclude that the victory of an Air battle will depend on whether we can secure combat effective pilots. With a high percentage of air combat effective pilots, a country should enjoy a high probability of winning. It would seem, then, that it would be appropriate to identify those characteristics which would aid in the selection of those individuals with potential as combat effective pilots. The next section will address the relevant pilot factors contributing to air combat effectiveness.

## B. ANALYSIS OF AN AIR COMBAT EFFECTIVENESS

### 1. Combat Effectiveness Criteria

Establishing air combat effectiveness criteria is the first step in evaluating air combat effectiveness. Although analysis of air combat effectiveness has been limited by the different environments in past engagements, this study will propose a basis for assessment or identification of the individual characteristics and critical skills which are thought to characterize a combat effective pilot.

Normally, the number of air kills is used as an aggregate measure of air combat effectiveness, and the most relevant data consists of those numbers. Air kill data, however, does not completely represent the level of air combat effectiveness since there are many other objective and subjective criteria of combat effectiveness. Furthermore, air kill data may be changed significantly if we consider together opportunity and the number of times shot down. For example, Erich Hartman, Germany's top ace with 352 air kills during World War Two, was cited as a model of air combat effectiveness. But, if one consider all of the facts, there was a tremendous opportunity for kills on the Russian front and he himself was forced down 18 times; roughly a 20:1 modified kill ratio, such that one may not have confidence in the total kill number [Ref. 14: p. 3-9]. This indicates more sophisticated models of air combat effectiveness are required.

Criteria relating to training should also be considered. Because training criteria have been more readily available, they have frequently been used for the selection of combat effective pilot. Such criteria, however, tend to select for training success, not for air combat effectiveness [Ref. 17: p. 5]. So, we must be careful in assuming that those who do well in training will necessarily go on to do well in a combat situation. While training criteria are

valid in predicting pass/fail in the pilot training program, they do not necessarily measure those qualities required for success in combat. A significant difference between combat effective pilots and average pilots (even non-combat effective pilots) might manifest itself only in the air combat situation.

A comprehensive study of air combat effectiveness was conducted by the McDonnell research team in 1977. The team identified thirty nine distinct criteria of air combat effectiveness. The thirty nine criteria identified had been the subject of various previous researchers with resultant conclusion concerning their effect. The list was divided into two categories, objective and subjective measures. Objective measures of fighter pilot combat effectiveness include the number of air kills, combat mission, enemy sight per combat mission, combat flying time, retention in the fighter pilot program,...etc. Subjective measures include ratings by superiors, peers, and psychologists [Ref. 14: p. 3-17]. These criteria provide the list for investigation in this thesis.

2. <u>Predictor Variables for an Air Combat Effectiveness</u>

The predictor variables related to combat effectiveness criteria are likely to be performance measures on test of various kinds, e.g., personality, decision making, reaction to stress, biographical variables, motor skills, aptitude, etc.

If one is able to identify a correlation between these predictors and combat effectiveness criteria, it will be possible to identify the best potential combat effective pilot through assessing the relevant factors. However, it is not easy in reality to assess all relevant predictors because of only partial relations of factors to criteria, as shown in the McDonnell team's report. According to the McDonnell team's analysis, there are 51 factors which

comprise a profile of the combat effective pilot, and 45 factors among them are recommended to test for the selection of substantial combat effective pilots. However, we can see from the Appendix B that the USAF in practise applies only 10 factors to their selection procedure [Ref. 14: p. 4-13].

We may determine which predictors are most significant to air combat effectiveness based on combat pilots relevances by reviewing some representative assertions. We can expect an acceptable result by assessing only some critical predictors which could be identified in our research to secure the best substantial air combat effective pilots.

A special study for prediction of a combat proficiency was conducted by Lepley (1947).

Pilot were rated on,

| | |
|---|---|
| (1) alertness | (5) conscientiousness |
| (2) personality | (6) air discipline and team work |
| (3) eagerness | (7) flying proficiency |
| (4) dependability | (8) compatibility |

by a special rating procedure. The product-moment correlations between ratings of pilots at the end of four months of training and ratings of the combat proficiency made by flight leaders after 9 to 16 combat missions yielded a correlation coefficient of 0.62. It indicates a better than random prediction (0.5) of air combat effectiveness [Ref. 19].

Straw Bridge and Kahn pointed out that flying experience, life history factors of parental control and striving, were most highly correlated with the indices of air combat effectiveness, while aggressiveness, risk taking, general information, flying hours had the highest correlations with the air kills data [Ref. 20].

Jenkins (1950) did a factor analysis on data of Navy pilots to identify characteristics of the "high group" of combat pilots.

Eight characteristics identified by Jenkins were,

(1) leadership and responsibility,
(2) team work,
(3) practical intelligence,
(4) combat aggressiveness,
(5) skill and interest in flying,
(6) seriousness and conscientiousness,
(7) coolness and steadiness,
(8) easygoing sociability.

The order of the above listings indicate the rank ordering assigned by Navy pilots queried [Ref. 21].

Torrence (1957) identified five factors that differentiated between aces and nonaces. According to his assertion, aces tended to

(1) exhibit fewer childhood neurotic behaviors,
(2) achieve better social adjustment,
(3) participate in a larger number of every day activities involving risk and strategy,
(4) test the limits of behavior as boys,
(5) receive more early independence training.

He pointed out that aces have greater motivation as indicated in interview data; this was evidenced by more attempts on the part of aces to become fighter pilots and overt efforts to obtain additional combat duty [Ref. 22].

Stanley (1973) suggested 10 significant factors in his thesis to distinguish the effective pilot and the ineffective pilot.

They were

(1) situation awareness
(2) procedure ability
(3) decision making capacity
(4) determination/fixation
(5) stress capacity
(6) lack of preparation
(7) excessive concern with self image
(8) self confidence/over confidence
(9) concern

(10) communication.

He emphasized the first five factors as the categories most likely to distinguish between effective pilots and ineffective pilots [Ref. 17: p. 25].

Aside from these assertions, Trumbull and Backstrol showed the importance to combat success of a strong preference to be fliers, and the weapon system evaluation group (WSEG) suggested that combat experience is a more important variable than flying experience in air-to-air combat success [Ref. 14: p. 3-30].

3. <u>Conclusion and Israeli Air Force Policy</u>

Although many researchers emphasized some relevant predictor variables for air combat effectiveness, it can be condensed into two main domains, individual characteristics and special air combat skills. According to the McDonnell research team's report, the importance of psychological traits was confirmed by statistical data and it was considered to be a direct bearing on a pilot's combat effectiveness [Ref. 14: p. 3-20].

Psychological testing plays an integral part in the Israeli's pilot selection and evaluation. This emphasis is borne out by the composition of the initial rating base for selection of pilot candidates (Table IX).

TABLE IX

IAF'S INITIAL EVALUATION RATING BASE

| ITEMS | PERCENTAGE |
|---|---|
| 1. Candidates' personality | 40 % |
| 2. Perceptual/Motor test | 30 % |
| 3. Background variables | 30 % |

* Source: 'Canopy Over Israel' by Norman H. Gray SEP 1978.

Following this initial evaluation, recruits are sent to a 10 day selection and screening camp with a new group of behavioral scientists and pilot/instructors to assess the candidates' motivation, ability to innovate, aggressive traits, leadership, and other traits as observed through their activities. The IAF's selection and training pipeline is detailed in Appendix C.

The IAF takes every necessary step in assuring that the best are selected. This will preclude expending resources on training of pilots who will fail at the end of the 20 month training period or would not ultimately be a combat effective pilot. In essence, the IAF believes that a combat pilot's personality may be more important than his individual flying skills.

The following are the 12 factors which the Israelis identify as predictors of potential pilot combat effectiveness [Ref. 14: p. 3-82].

(1) General intelligence,
(2) Physical health,
(3) Mental health,
(4) Risk taking,
(5) Personality,
(6) Motivation,
(7) Aggressiveness and determination,
(8) Courage
(9) Stress,
(10) Leadership,
(11) Tactical judgement,
(12) Decision making.

It is difficult to determine exactly what IAF policy seeks. One can see, however, they emphasis on psychological traits for pilot selection and evaluation. This agrees with various studies, since most researchers have pointed out the high correlations between individual characteristics

(psychological traits) and a pilot's air combat effectiveness. The result of these various studies is consistent with current IAF policy.

The influence of special air combat skills might be considered of secondary importance in terms of the overall predict ability concerning an air combat effective pilot, though it is a final direct factor of victory in an air combat.

One may conclude that psychological traits and combat skill will determine the air combat effective pilots and they will decide the level of air combat effectiveness. This conclusion has been supported by the IAF's overwhelming victory records.

## C. THE PROFILE OF AN AIR COMBAT EFFECTIVE PILOT

### 1. <u>Two Main Characteristics of a Combat Effective Pilot</u>

According to Mark Heller, pilot selection and promotion in Syria are influenced by communitarian and party considerations [Ref. 3: p. 234]. This Syrian policy may presume that the pilot devoted to the party is a combat effective pilot. However, there was no correlation between the party affiliation and air combat effectiveness, even discounting their miserable air combat record. In like manner, the lion-hearted bravura, like that of the Kamikaze pilot in World War Two, is not a sole contributing factor for a pilot's air combat effectiveness.

A profile of a combat effective pilot can be derived by viewing the individual characteristics and critical combat skills of an air combat effective pilot as discussed in section 2. The individual characteristics will be considered a more significant factor to the profile.

#### a. Personal Characteristics of an Air Combat Effective Pilot

Two research studies, McDonnell's and Stanley's, propose some ideas which can determine the relative importance of each item among the individual characteristics.

The McDonnell research team identified 12 personal characteristics which are significant to the combat effective pilot, as determined by interviews and the pertinent literature. The KAF pilots' opinion concerning these items are listed in Table X.

TABLE X

PILOT OPINION OF IMPORTANCE OF SELECTED CHARACTERISTICS

* % of Pilots Responding under each Level of Importance

| Personal Characteristics | Critical | Very Important | Important | Fairly Important | Not Important |
|---|---|---|---|---|---|
| Aggressiveness | * 46.4 % | 41.7 % | 7.9 % | 3.2 % | 0.9 % |
| Determination | 41.9 | 44.6 | 12.6 | 0.9 | 0.0 |
| Desire to achieve | 43.3 | 41.3 | 12.4 | 2.4 | 0.6 |
| Initiative | 33.3 | 47.3 | 15.8 | 3.0 | 0.6 |
| courage | 32.6 | 40.9 | 19.7 | 5.0 | 1.8 |
| Willingness to take risk | 33.4 | 35.8 | 17.3 | 11.7 | 1.8 |
| psychological stress toler' | 27.5 | 39.5 | 25.1 | 6.0 | 1.8 |
| physiological stress toler' | 21.1 | 37.1 | 30.3 | 10.1 | 1.5 |
| Anxiety tolerance | 22.2 | 35.0 | 28.1 | 13.2 | 1.5 |
| Team cooperativeness | 17.5 | 40.1 | 30.6 | 9.8 | 2.1 |
| Endurance | 14.8 | 42.3 | 31.4 | 9.5 | 2.1 |
| Leadership | 16.7 | 35.2 | 34.0 | 10.5 | 3.7 |

Approximately 85 percent of the pilots answering this questionnaire rated 'desired to achieve', 'aggressiveness', and 'determination' as being critical or very important personal characteristics. The factors of 'courage', 'initiative', and 'willingness to take risk' were rated critical or very important by approximately 70-75 percent of the pilots [Ref. 14: p. 3-104].

Through interviews with 30 combat experienced pilots, Stanley defined 8 categories of behavior which characterized combat effective pilots and 9 categories which characterized ineffective pilots. He combined these categories and rated them (Table XI).

TABLE XI

RANK ORDERING OF CHARACTERISTIC RATING TOTALS

| | ( Ratings ) | | | |
|---|---|---|---|---|
| Categories | Effective | Ineffective | Total | Rank |
| Situation awareness | 85.5 | 76.7 | 162.2 | 1 |
| Procedure ability | 77.6 | 76.2 | 153.8 | 2 |
| Decision making capacity | 39.0 | 113.5 | 152.5 | 3 |
| Determination / Fixation | 68.0 | 56.9 | 124.9 | 4 |
| Stress capacity | 87.3 | 19.1 | 106.4 | 5 |
| Lack of preparation | -- | 38.2 | 38.2 | 6 |
| Excessive concern with self image | -- | 28.6 | 28.6 | 7 |
| Self confidence / over confidence | 9.7 | 19.2 | 26.9 | 8 |
| Concern | 9.7 | 19.0 | 26.7 | 9 |
| Communication | 19.4 | -- | 19.4 | 10 |

* Rating = (% of total) x (% unanimous) x 1000

He discovered that combat performance may be assessed by evaluating relatively few aspects of an individual's behaviors, and he emphasized the five categories with highest total ratings as predictors for an air combat effective pilot.

Since these two studies have been linked by statistical data, characteristics from them can be used in our model to select the air combat effective pilot, based on the relative weight of each item. Because it was obtained from more reliable sources; the literature, narrative comments by actual aces, and questionnaire responses from

373 fighter pilots [Ref. 14: p. 3-105], the McDonnell research team's data will be used to consider the predicted effectiveness of NPS Korean pilots' effectiveness.

b. Special Air Combat Skills.

Some other factors besides the personal characteristics have high correlations with air combat effectiveness. In particular, flying time, age, and military career have a significant correlation with air kill data and can be included in the characteristics of an air combat effective pilot. However, these factors have little value as a selection factor for combat effective pilots since the pilot only attains these characteristics after his pilot training program.

Some combat pilot skills may serve as predictor variables in the selection process, particularly for general pilots selecting for combat training.

The McDonnell research team identified nine critical skills and abilities through their literature and pilot interviews. They rated the results of pilots' opinion about the relative importance of those 9 factors concerning flying, perceptual, and judgemental skills (Table XII). The most surprising result of this set of ratings was the fact that 'obtaining early visual target acquisition', not a flying skill, appeared to be the most critical factor of achieving combat effectiveness [Ref. 14: p. 3-105].

While these skills and abilities are important in determining the combat effective pilot, they are not as important as the personal characteristics addressed earlier.

2. <u>Conclusion</u>

A comprehensive description of the combat effective pilot is provided by G. Gurney (1961) [Ref. 18].

> The ace flew aggressively and always pressed his attack. He was not necessarily reckless nor foolhardy, but he was daring and a fighter. He loved to fly and knew his business when he had the flying machine strapped on by the safety belt. He was constantly on the

TABLE XII

MEDIAN RATINGS OF CRITICAL COMBAT PILOT SKILL

| Ability to : | * Median Ratings |
|---|---|
| 1. Obtain early visual target acquisition. | ( 5 ) |
| 2. Perceive/judge target direction and rate of turn, aspect angle, angle off, TCA, range, closing rate, track crossing rate. | ( 1 ) |
| 3. Keep track of critical flight parameters (speed, alt', att', angle of attack, 'G') | ( 0 ) |
| 4. Select and executive the best maneuver to gain a firing position (yo yo, B/roll...etc) | ( 3 ) |
| 5. Judge when to shoot. | ( 1 ) |
| 6. Shoot well (both tracking, or raking shot when tracking was impossible). | ( 0 ) |
| 7. Handle the throttle (s) and speed brake (manage energy). | ( 0 ) |
| 8. Keep track of the other a/c - wing man, hostiles. | ( 1 ) |
| 9. Judge when to leave the fight. | ( 0 ) |
| 10. Other | ( 0 ) |

* The higher the rating value the more important the skill. A zero rating means it was not selected as in the top five by over one-half of the pilots responding.

alert for the enemy and his experienced eyes were able to catch that flicker of motion, that flashing speck on the horizon, that almost unseen movement that was sometimes the only indication that an enemy was sharing the same sky. In some cases, aces have been able to run up an impressive number of victories because of their exceptional shooting abilities, but while this ability often made a difference in final totals, it seldom alone made a flyer an ace. The ace understood his business, learned from his own experience and from that of others, carefully employing these tactics which put to greatest advantage his fighting vehicle. With this combination of fighting attributes the ace seized the advantage to sweep the enemy before him.

In summary, one can say the combat effective pilot should have psychological and physical fitness, preference and pride for flying, special combat skill, combat experience, and knowledge about the mission and job. The greatest

likelihood of producing a combat effective pilot is through selection based on all of these relevant factors. However, in reality, it is impossible to apply all relevant factors (assessed or not assessed) to pilot selection and the evaluation, as mentioned before. It is, therefore, more appropriate to consider some critical predictors for selection, such as those individual characteristics pointed out by Stanley [Ref. 17: p. 25], than trying to consider all relevant factors.

The next chapter will analyze KAF combat pilots' self-report data against the personal characteristics and special combat skills from the McDonnell research team report.

# IV. AN ANALYSIS OF THE PERSONAL CHARACTERISTICS AND COMBAT SKILLS OF KOREAN FIGHTER PILOTS

## A. ANALYSIS OF NPS KOREAN PILOTS DATA

### 1. Methodology

The best way to analyze particular phenomena is through observational data of the actual event or activity. However, time, economic, and spatial constraints preclude the gathering of such data in many cases, and necessitate the study of some surrogate activity.

Accordingly, it would be preferable to have actual KAF air combat data for analysis and generation of a model of air combat effectiveness. Such a model would be more comprehensive as it would capture specific data not available for a generalized model. However, historical reality has determined that there is no actual combat experience among current KAF pilots and consequently no combat data. As a surrogate, we will use KAF fighter pilot self-report data as structured by previous studies. The combat effectiveness of KAF pilots will be generalized from our literature review which provides insight regarding the model of air combat effectiveness.

Although there are many ways to assess a specific traits (e.g., paper and pencil tests, perceptual-motor skill tests), it is better to assess all relevant factors together. The micro-computer based LOTUS 1.2.3[5] electronic spreadsheet program proves to be an excellent means for this purpose, although it was designed for use in many diverse general applications.

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[5] "LOTUS 1.2.3 is a desk top computer programs. It combines the advanced electronic worksheet yet developed with graphics and a information management capacity"

The relevant factors in determining a combat effective pilot were addressed in Chapter III. The McDonnell research team's survey data resulting from the most comprehensive study is used for the analysis. The 'LOTUS 1.2.3' model assesses KAF pilot self-report data related to both critical factor areas, pilot's personalities and combat skills, which have been validated as main variables of a combat effective pilot by McDonnell team.

The model will identify the predicted most combat effective pilot as well as determine which factors are the most significant to the KAF case.

2. <u>Survey Data and Relative Weights</u>

a. Survey Data

The surveyed Korean Air Force pilots at the Naval Post Graduate school were selected to attend by a set of selection criteria (English test score, academic grades, general evaluation grades, etc). The selected 12 pilots had more 1000 hours fighter flying time each and more than 5 years in a tactical fighter squadron which was considered enough experience to make them credible respondents.

Although suspicion might arise about the objectivity of a pilot's response, the data is considered unbiased and suitable for the demonstration since they knew it would not have any influence or effect on their career or school performance, as well as the fact that it was an anonymous survey (Appendix D).

b. Relative Weights

Although many researchers have pointed out the importance of personalities over combat skills and that the IAF has applied the study results to their selection/ evaluation system, we will assume an equal weight between personalities and combat skills in our model because there is no way to judge a relative weight between them.

The relative weight for the personal characteristic factors can be assigned through the results of the McDonnell study. From table X, the left column indicates the percentage of pilots who think a factor is critical, and we will weight those items by "each item's percentage/sum of the total items' percentage".

Table XII shows the 9 combat skills which were identified by the McDonnell research team, and we will use the top 5 skills among those relevant factors since those 5 items were rated with non-zero median ratings. But, one can not put a relative weight on the items since non-zero median ratings do not directly represent a value of relative weight. ratings were included in the 9 total items). Therefore, we will apply equal weights to the top 5 items in our model, simply to demonstrate the results.

3. <u>Result</u>

The result of the LOTUS model, the 12 sample pilots' relative ratings as air combat effective pilots, appear in Appendix E, with the overall ratings shown in Figure 4.1 for demonstration.

We can say from the Figure 4.1 that pilot 2 is the most effective pilot and pilot 5 is the least effective pilot based on the two general factor groupings. Such results can be used to identify the potentially combat effective pilot among the pilot candidates or general combat pilots.

Besides the overall ratings of NPS Korean pilots' psychological characteristics and special combat skills, we can obtain more specific data of each grouping. Results may supply valuable information impacting on the future policy of pilot management of the KAF. For example, the average weighted ratings of the NPS Korean pilots' psychological characteristics highlights a lack of 'aggressiveness' and 'willingness to take a risk' (Figure 4.2). The NPS Korean pilots' characteristics might be due to their special

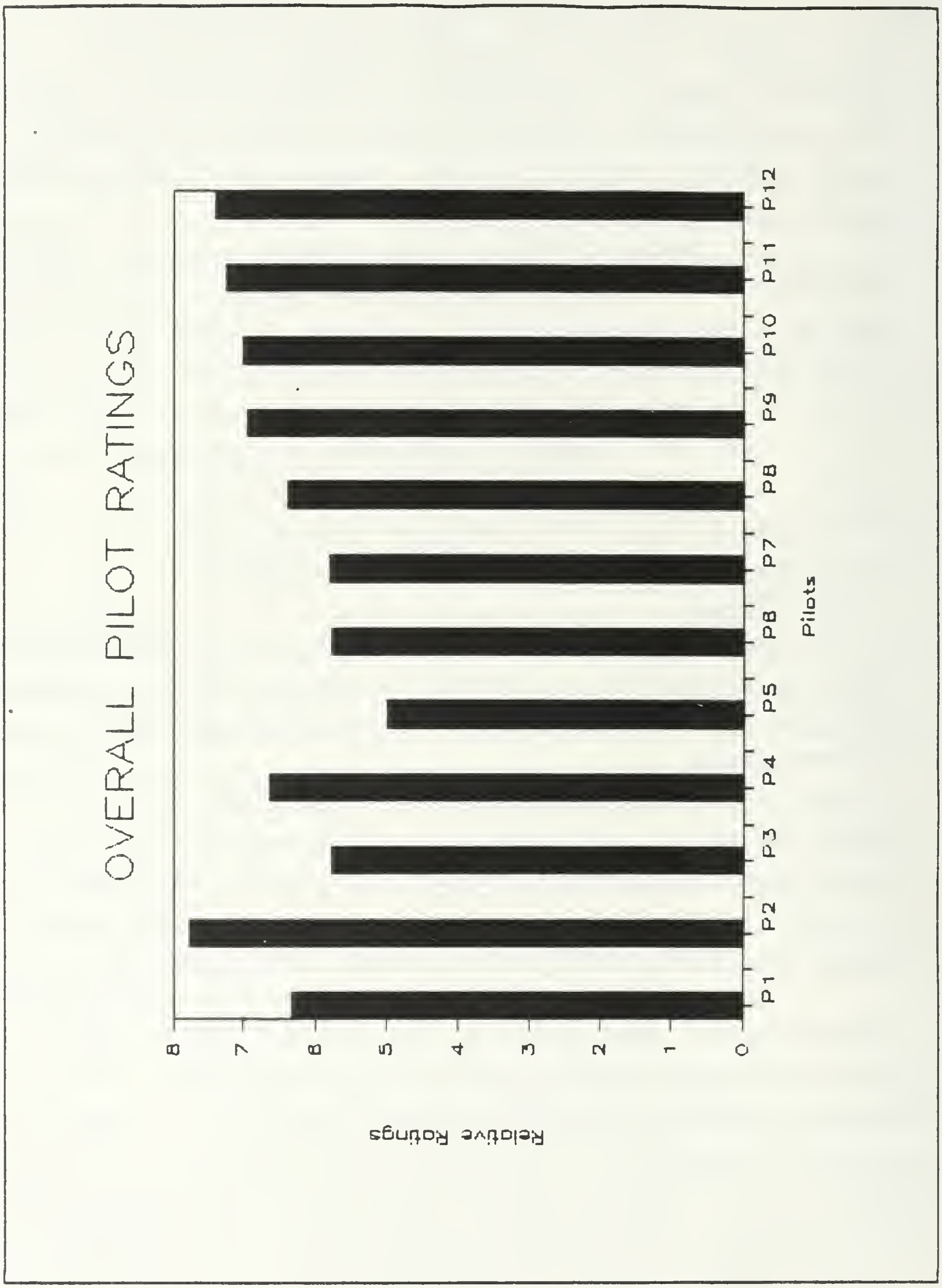


Figure 4.1   Overall Rating of NPS Korean Combat Pilots.

personalities since they were selected to study voluntarily, or due to a KAF's basic flying philosophy: Safety is Paramount. Regardless of its exact reason, the important thing to note is that some fighter pilot may be identified as having a weakness in a particular characteristic area with its resultant impact on the individual's air combat effectiveness. Presumably, something could be done to strengthen the weakness to the improvement of combat effectiveness.

Based on the analysis of results of the LOTUS model, we may assess all common pilots and pilot candidates objectively and effectively, and it will be used as a direct reference for a combat effective pilot management. Finally, KAF should focus on this kind of data analysis; overall ratings, each pilot and each specific item, and average group analysis to secure more substantial combat effective pilots and manage them scientifically for the increased air combat readiness.

4. <u>Recommendation for an Actual Application</u>

There is a no doubt that 'LOTUS 1.2.3' model has a powerful function to assess all relevant factors together. But, that point is not so important since our goal is a selection of combat effective pilots and an improvement of air combat effectiveness as a result of it, not finding a powerful executive model itself.

The result of LOTUS model will be influenced by the specific test data and relative weights assigned to the factors. The result in Figure 4.1 would change significantly if actual air combat input data and calculated weights are used instead of subjective survey data with assumed relative weights. The evaluation of each pilot's characteristics, skills and relative weights should be performed first in order to obtain meaningful ratings among the candidates or general pilots being assessed for combat effectiveness potential.

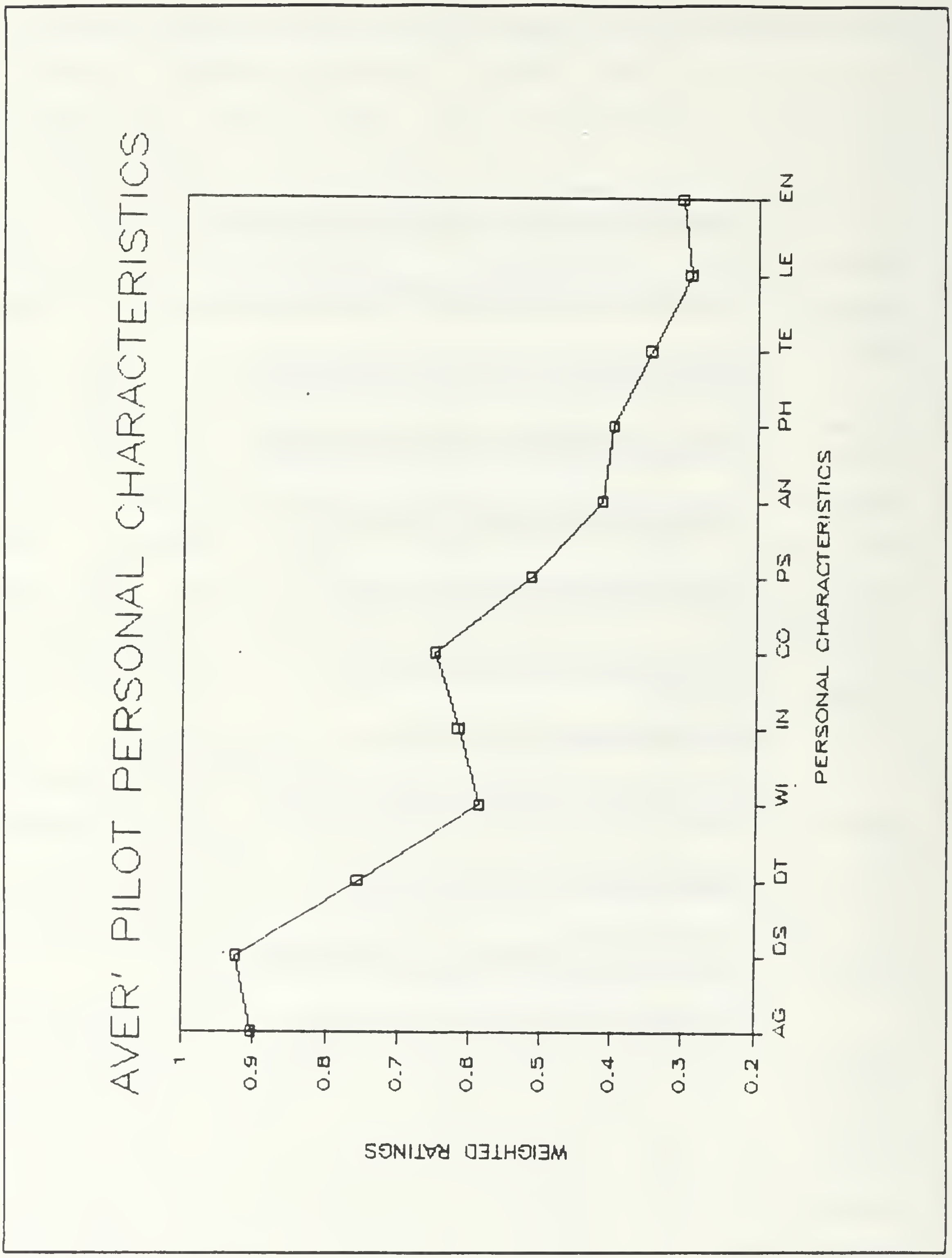


Figure 4.2 The Average Weighted Rating of Psychological Characteristics.

The application of the Air Combat Maneuvering Range/Instrument (ACMR/I) system may help refine the task by being able to more closely simulate air combat data from which it is possible to determine correlations between relevant factors and air combat activities. Although it is not equivalent to actual combat data, the data of the ACMR/I system is valuable in representing an air combat situation in which it is possible to trace each maneuvering, aircraft controlling, relative positions with target, and weapon success, ...so on [Ref. 14: p. 6-2]. Furthermore, the ACMR/I system can simulate present air combat characteristics and be modified in the future for future aircraft advancement. ACMR/I data is able to be generated with current aircraft and weapon systems, while past research dealt with World War Two and Korean War scenarios. Data from the current ACMR/I system of the KAF should be used for this data analysis, as well as data from direct combat training. If the ACMR/I and training evaluation systems are employed effectively to determine correlations between relevant factors and ACMR/I performance data, more reliable output data from the model assessing all factors could be expected.

If longitudinal studies of KAF simulate and training combat effectiveness were to begin as early as now, it would take upwards of 5 years to track a pilot from candidate to combat ready fighter pilot with 3 years experience. This implies a long range study necessary to obtain sufficient significant data for analysis. The effort would be worth the cost, since once some critical factors related air combat effectiveness and relative weights among them are established through a simulated combat performance data analysis (by ACMR/I, or other computer system), it can be used to assess and select with greater confidence potential air combat effective pilots from among pilot candidates and general pilots.

Expected benefits include a reduction in training cost through a reduced wash-out rate and an enhanced air combat capability through identification and selection of more combat effective pilots, and should easily outweigh the costs of research and program implementation. research cost and endeavour absolutely.

## B. IMPLICATION FOR PILOT QUALITY CONTROL

### 1. Securing the Best Pilot Candidates

In the discussion thus far, it is evident the level of air combat readiness depends on securing and maintaining a force of air combat effective pilots. The importance of the combat pilot has increased due to more complex and costly aircraft and systems, and the increasing complexity of warfare. Combat effective pilots are of primary importance in the attainment of air combat readiness, and combat pilot quality related directly to the quality of pilot candidates.

It has long been apparent that, in general, top quality pilots began as top quality candidates and conversely a lesser quality candidate could be expected to become a lesser quality pilot. This echos a Biblical passage that a good tree will produce a good fruit.

Regardless of the numbers of pilots introduced into the force, if good quality individuals are selected a certain number of good pilots should result. Many countries, however, seem to deal in number only, accessing the number of pilots necessary to fill a combat squadron's requirement and provide for replacement of detachers and attritors. If an Air Force can not or chooses not to induce higher quality candidates to be a pilot, it is hard to secure combat effective pilots regardless of how good its selection/evaluation system.

Selection of good quality individuals is possible when the most high-school graduates are motivated to enter

pilot training. That motivation may take the form of something such as the cares of operating a $26,000,000 state-of-the-art aircraft. It is not incidental that the IAF has been able to maintain a high state combat readiness and the fact that to be a pilot in the IAF is the ultimate ambition for most young male Israelis.

Because of the combat pilot's critical value to the KAF and the country, promoting high-school graduate interest in being a pilot should be a national concern and not just that of the Air Force. As a consequence of Israeli universal military service, pilots can be carefully selected, despite the small total population base. Israel acknowledges the view that the stature of the IAF fighter pilot is high in the eyes of the Israeli people, and the pilots receive exceptional consideration in matters of selection, training, and treatment [Ref. 5: p. 15].

In a word, one should secure more qualified resources for the selection of a more combat effective pilot in order to improve air combat readiness. Motivation for voluntary application might be provided by mass media advertising and recruiter activity in a short term, and by improving the treatment[6] of the pilot in the long term.

Certainly there are trade offs. But it would be better to invest the cost of one aircraft to help secure higher quality pilots than to have one additional aircraft with a mediocre pilot. The lessons of past air battles tell us that to fight an air battle with mediocre pilots does not mean one or two aircraft lost, but rather 50, 100, or hundreds aircraft.

[6]When a pilot attain the rank be Major in the IAF, he is provided housing, and half the cost of a car. As a LCOL, housing, a car, gasoline, and utilities are the rewards.

### 2. Assessing Pilot Candidates

Presuming the accession of a sufficient quantity of high quality pilot candidates, the next step is the screening of candidates for those qualities that make a combat effective pilot.

The current assessment system for the KAF pilot candidates i.e., Academy cadets, based on the entrance examination score for the KAF Academy, is insufficient for our purposes. Although KAF uses a pilot aptitude test and interview for these candidates, besides an entrance examination, there is a considerable need for improvement since the results of the aptitude test and interview have been used as secondary means of candidate selection. Furthermore, if candidate camouflages himself intentionally to pass the entrance barrier, valid assessment is difficult under the current system since most results are assessed by the cadet discipline officer and other instructors, not by selection experts.

This failure to employ selection experts is the big difference between KAF and IAF selection/evaluation systems. The IAF considers the candidates' psychological characteristics and other pilot test (aptitude, psychomotor, and cognitive) data more important than intellectual comparisons. Their evaluations emphasize psychological assessment of pilot candidates by the special psychologists and pilot instructors based on the average I.Q. candidate (Appendix C).

Similar selection criteria can be discovered in the Canadian Air Force. Their current test battery for the pilot candidates consists of a psychomotor test, a pencil and paper test which addresses verbal and quantitative aptitudes, a memory test, a measure of cognitive style, the Group Embedded Figures test and selected scales from Jackson's personality research form [Ref. 23: p. 701].

In order to stay at the leading edge in selection, the KAF needs to change its emphasis in the pilot candidate assessment system from intellectual measures to the psychological factors and other relevant testing if it desires optimum selection for combat effective pilots. The psychological factors and pilot aptitude test data should be examined carefully because this data reflects the candidates' mental attitude which is considered more critical than actual combat skills. Aside from the importance of psychological factors, the significance of pilot aptitude can be seen from the results of Royal Air Force (RAF) research. The relationship between a pilot aptitude test data and RAF Flying Selection Squadron[7] grades is shown in Figure 4.3. High correlations are evident in the figure shape and rejection distribution [Ref. 24: p. 716].

Of course, other pilot-relevant tests such as psychomotor and cognitive tests can be used to assess pilot candidates, specifically in terms of their potential for flying [Ref. 25: p. 125]. Accordingly, it is a matter of priority that the pilot candidate assessment program at the KAF Academy be conducted by experts (psychologist/pilot instructors/data analyst) specializing in this area. The assessment program at the KAF Academy should be the main focus for improvement, because the combat effective pilot will be selected from among this group.

This strengthening of the assessment program can be facilitated through the use of a computer model like as 'LOTUS 1.2.3' to assist in assessing all relevant factors and evaluation of each candidate. Such computer aids will assist in the analysis of pilot candidate selection and training.

[7]this squadron was made for the prediction of success in later flying training, and its activity was evidenced by high correlations between their grades and success/failure results in later training.

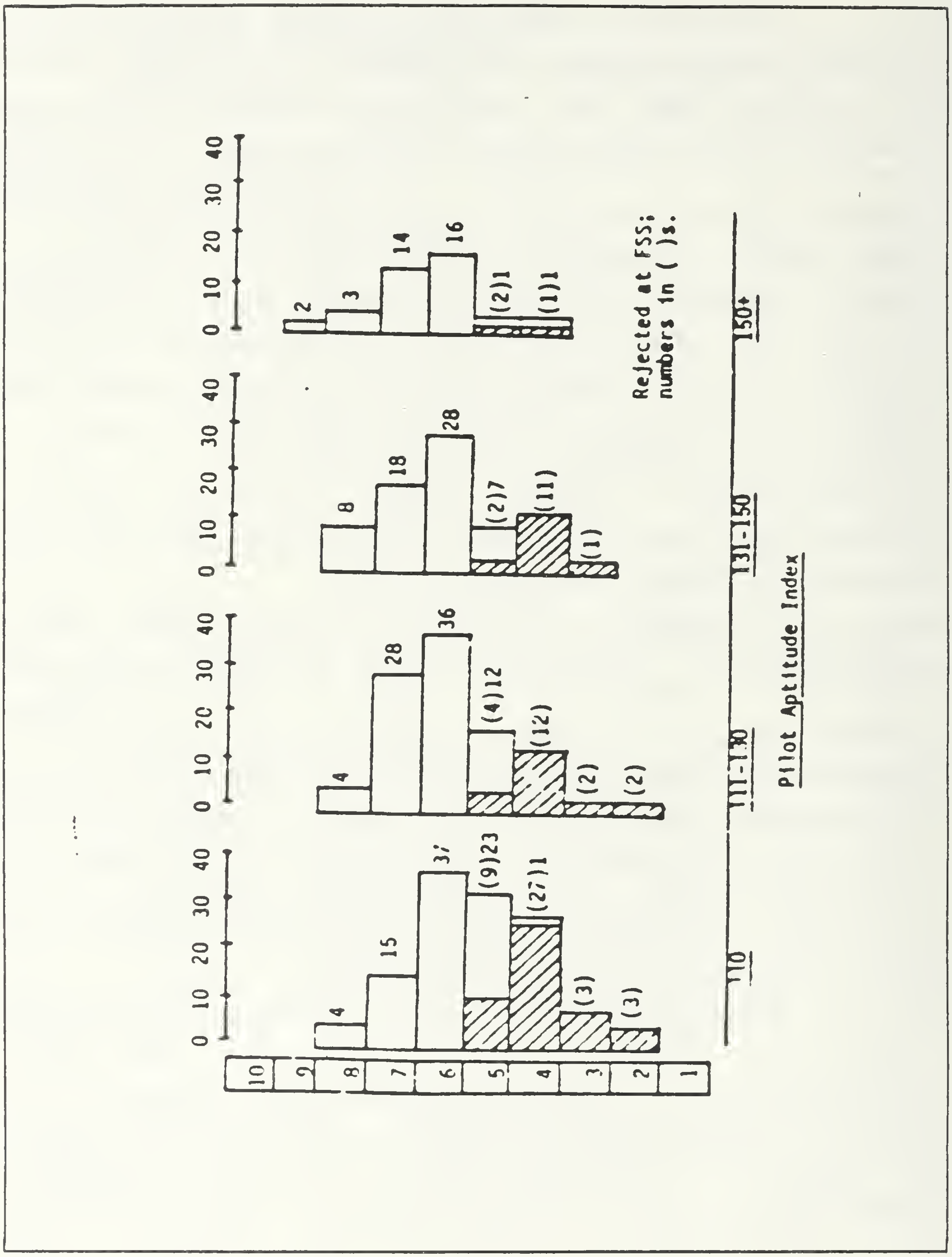


Figure 4.3 Relationship Between Pilot Aptitude Scores and FSS Rejections.

3. Training

Large differences were evidenced among the personal characteristics and combat skills of the NPS Korean pilots surveyed. The existance of these differences supports the necessity of specialized targeted training to strengthen deficiencies and, ultimately, to improve the total quality level of the pilot corps.

Training some pilots to be combat effective will enhance most of pilot quality control effect unless we can find a way to secure perfect pilots directly. In our search for perfect pilot the following discussion will focus on training to support the factor of personal characteristics and combat skills which are essential to air combat effectiveness.

a. Specialized Training in Combat Skills

It would be of great benefit to the attainment of combat effectiveness if deficient combat skills, skills essential to success, could be strengthened through special training. Fortunately, it appears that air combat skills can be taught. The definitive evidence of the positive effect of specialized training for an air combat effective pilot comes from Navy pilots' kill ratio in Vietnam War. Prior to the introduction of the Navy's Top Gun School where pilots fly against dissimilar aggressor aircraft, the kill ratio was 2.5 : 1 ; after Top Gun training the kill ratio jumped to 12.5 : 1 . While this improvement may be due to selection practices of sending only the "better" pilots to Top Gun School, or just due to luck, it is usually seen as an evidence of the effect of a combat specialized training [Ref. 26]. This result may be explained also by Weiss assertion which emphasized the significance of a survivability in first some decisive encounters. According to his assertion, those pilots who survive their first 5-8 decisive encounters then evidence a high probability (about .98) of

surviving subsequent decisive encounters [Ref. 14: p. 3-9]. Having experienced their first encounters in training they are able to gain the survivability edge in a not life-threatening environment.

Comparison data in Table XIII provides a limited but contemporary indication of the value of specialized pilot's training.

TABLE XIII

USAF-USANG SHOOTING COMPETITION DATA

| Event | Result | |
|---|---|---|
| 1. Average shooting score | < USAF > | < ANG > |
| - MDB( angle 30) : CEA | 44 ft | 34 ft |
| - LADB( angle 15) : CEA | 43 ft | 44 ft |
| - GUNNERY : Strafe Percentage | 68 % | 68 % |
| 2. Individual overall winners in their respective events | | |
| < F-100 Vs A-7 > | < F-100 Vs F-4 > | |
| - Top strafe : ANG | - Top strafe : ANG | |
| - Top LADB : ANG | - Top LADB : USAF | |
| - Top MDB : ANG | - Top MDB : ANG | |
| - Top Gun : ANG (overall best pilot) | - Top Gun : ANG (overall best pilot) | |

* MDB - Medium Angle Dive Bomb
* LADB - Low Angle Dive Bomb
* CEA - Center of Effective Area

In a bombing competition, the results of 8 antiquated F-100s of the US Air National Guard (ANG) vs 8 A-7s (one of the most sophisticated bombing aircraft) of USAF and the results of 4 F-100s of USANG vs 20 F-4s USAF were shown on Table XIII. These statistics indicate that while the ANG pilots fly older aircraft, they compensate for this deficiency by their specialized training. They may remain in the same units and flying the same mission for their entire career [Ref. 13: p. 15].

This kind of specialized training has been applied strongly in the Israeli Air Force. The pilots in all combat squadrons of the IAF that are not in the Operational Training Unit (OTU) program fly the same schedule each day for a 4-month training cycle. On all missions during the basic training phase in the OTU program, Air-to-Air, Air-to-Ground, Formation, and Night flying are mixed to prepare the pilot for the unexpected. The IAF considers Air Combat Maneuvering (ACM) proficiency to be the true test of their pilots' airmanship. Accordingly, 80 % of training is dedicated to Air-to-Air dog fighting - 20 % to Air-to-Ground missions [Ref. 5: p. 21].

The position of the USAF on the importance of Air-to-Air training is similar to the IAF position, though for a different reason. For example, F-4 wings are designated for either primary Air-to-Air or Air-to-Ground missions. Some 65 % of training is supposed to be directed to the primary mission, though, in the past, USAF training for F-4 squadrons had been about evenly divided between Air-to-Air and Air-to-Ground training. More recently, however, the USAF is placing more emphasis on Air-to-Air combat training out of consideration for the reduced Air-to-Ground opportunities as a result of Soviet and Warsaw Pact emphasis on shelters, dispersal, decoys, camouflage, and intensive air defense networks. The increased number of enemy aircraft saved on the ground will be seen in the air.

Former General Dixon who was a commander of the USAF Tactical Air Command (TAC), acknowledged specialized training as a key part USAF TAC modernization plans [Ref. 27: p. 30]: "Training specialized air crews provide a maximum return on limited training resources".

Finally, the IAF feels that specialized pilot training for the Air-to-Air mission will provide "air combat experts" which will gain victory in the air. Pilots who have

been trained specifically for Air-to-Air mission can convert easily to other missions after earning their air superiority credentials. It is essential that the KAF train more pilots through a concentrated training program of specific combat skills and experiences, such that actions taken in the initial air combat will lead to victory.

Since the KAF is numerically inferior to the North Korean Air Force and Seoul, the capital of Republic of Korea, is too close to the De-Militarized Zone (DMZ), the KAF must be able to marshall almost all aircraft for air defence to protect Seoul and vicinity area in the event of enemy attack. This anticipated scenario precludes, during the initial stages of warfare, the allocation of air power to other missions such as Air Defense, CAS, Interdiction, and Air Offence. Consequently, a specialized Air-to-Air training should be considered as a first priority for the KAF because other missions are feasible only after victory in the initial air combat.

Specialized training for each pilot can be more effective if focused on specific skill weakness identified during initial assessment of predictor skill factors. ACMR/I is an excellent medium for identifying each pilot's strengths and weakness in air combat maneuvering. The results of subsequent analysis will help determine future individual general or special training.

Specialized individual training focused on success promoting skills is a resource draining enterprise. To compensate for individual weakness not addressed through training due to training resource constraints, it is possible to magnify the individual strengths through the synergism of group performance. The synergistic strength could be the rationale behind the existance of special combat squadrons, like the IAF Hunter squadron. There is a multiplier effect of top quality pilots and specialized

training programs. The KAF would benefit from establishing some special combat squadrons to strengthen its specialized air combat training program in expectation of greater combat effectiveness. A selected air combat squadron could expect a higher kill ratio, and would be sent first into battle while other squadrons take another missions (CAS, Interdiction, or CAP). If pilots are sent into combat against an enemy with good fliers without adequate specialized Air-to-Air combat training, high attrition, poor combat effectiveness, or both, could be anticipated [Ref. 14: p. 1-10].

b. Psychological Training for Personal Characteristics

Although most researchers and the IAF have concluded that the psychological factors are more important than the combat skills, the level of training to psychological factors has not reached the level of combat skill training. Because psychological training in military has been considered synonymous with military discipline which can be imparted by training instructors or discipline officers, it has not been developed in a meaningful way for air combat effectiveness despite its implication for enhanced effect. Psychological training for future pilots does not imply solely a military discipline regimen, though it might include that. The fact that the IAF employs special psychologists and pilot instructors to select combat effective pilots suggests a special attention to the psychological factors area.

No matter how well select pilot candidates psychologically, there exist quality differences among the groups and among each individuals. Appropriately, psychological training should be administered to supplement and reinforce these characteristics in keeping with the concept of human potential. The tour at the Air Force Academy could be used for this training. While the IAF starts flight

training just after a selection stage, 4 years of academic life with special attention to developing Cadet psychological characteristics should help the Cadets strengthen those characteristics which have been shown to be positively correlated with air combat effectiveness.

The current standards of Korean Air Force Academy Cadet honor; to keep the rule well, good grades from studying, and good peer/upper class ratings are not peculiar to combat effective pilots, who require some unique personal characteristics (Aggressiveness, Desire to achieve, Determination, etc) compared with other military academies cadets. It would seem appropriate that KAF Academy set up a psychological training program designed to develop in each cadet the optimal psychological profile for an effective pilot. A special staff of expert psychologists and experienced pilot instructors at the Air Force Academy would be charged with selection of potentially combat effective candidates, to determination of each cadet's strong/weak points, development of individual/group training programs, and progress monitoring.

Although the current KAF Academy program may cover many parts of special psychological training, there is a difference between systematic and casual training. The temperament of the effective combat pilot is unique and a systematic approach to developing that temperament is essential.

The recognized importance of personal characteristics for the combat effectiveness and the possibility of training to human characteristics is fundamental to a program of cadet psychological training at the KAF Academy and warrants attention.

### 4. Pilot Management

After the initial training of combat pilots, it is important to effectively manage them for the highest combat readiness. Disregard for the management of combat pilots is equivalent to pouring water into a leaky jar. The impact on the USAF of high attrition reveals the importance of pilot management.

For force readiness a primary consideration in pilot management is keeping pilots in a "cockpit only" status as long as possible. However, there are many intervening requirements which challenge the concept: Staff abilities, Leadership experiences, Education level, and Individual pilot's retention. Furthermore, we can not recklessly push pilots to be "cockpit only" since the human being is not a machine. Some accommodation must be made between the requirement for "cockpit only" pilots and many other competing requirements.

The IAF maintain their pilots in maximum "cockpit only" status. When pilots are assigned to headquarters for duty they must, and do, maintain their combat flying capability by returning to their squadron at its base twice a week, and when assigned to be instructors, they must return and fly with their operational squadrons once a week - and for 1 week every 4 month. Although one may anticipate some trouble performing in their current job (flying instruction/ headquarters duties) and even safety problems, the general thinking of the IAF is that every pilot is a pilot first, last, and always [Ref. 5: p. 19]. According to the USAF magazine, the estimated ratio of assigned pilots (20,781) to aircraft (7,343) for FY '86 is about 2.8:1 [Ref. 28: pp. 190, 196], while the IAF's ratio is 2.4:1. But, if one considers second line pilots' combat ready status, the relative ratios may be reversed. IAF policies appear to compensate for numeric inferiority by maximum aircraft turn arounds with sufficient pilots.

The KAF that has a policy similar to that of the IAF with regard to flight currency for second line pilots' combat readiness. However, many second line pilots of the KAF, except those on air bases, should not be sent to air combat directly, since they fly trainer type aircraft with instructors (not their original type fighter) for their flight currency. Therefore, the current KAF policy may help second line pilots to maintain a flying sense, but extra requalification would be needed to use them in actual combat. The pilots/time/aircraft required to requalify them in wartime may not be available unless those assets are made available through pre-hostility planning. In considering the prevailing concept of modern war (total, lightning war), the significance of "current available" pilots is apparent. The KAF should consider a strengthened flight proficiency maintenance policy with pilots assigned to their fighter types.

A further consideration for pilot management is the maintenance of the traditional atmosphere of a combat squadron which allows pilots to concentrate on only things of combat mission relevance; studying aircraft capability, weapon systems employment, tactics, enemy identification, mission assessment, etc. To this end, a current pilot's load should be assessed with non-flight related requirements (e.g., reports and administrative jobs) delegated as much as possible to non-pilot officers.

In the Korean Air Force 'SAFETY' magazine, one pilot detailed the tight daily schedule of a combat squadron; unnecessary meetings and desk work, a heavy dispatch rate, a deficiency of present pilots, and frequent alert duties, obstacles to flying safety [Ref. 29: p. 38]. All of these things should be considered in terms of the combat pilot's primary activities. If these are even critical to the flying safety issue, one can imagine the lack of real air combat

training. All concern might become absorbed with daily routine schedules. It would be prudent to try to alleviate the combat pilot's unnecessary loads and stresses by accessing more pilots and support personnel. It would help pilots to concentrate on combat related work; to prepare for combat missions and to improve physical strength, at least while they are working in a combat squadron. It may be a good for the KAF to note that the IAF has limited its conversion training to once a year per combat squadron, normally for their typical combat mission, and they have trained younger[8] pilots and assigned major missions to them based on their combat abilities. [Ref. 5: p. 20].

In addition to the active atmosphere of a combat squadron, it is important to maintain high morale amongst the pilots throughout the combat squadron's life since most KAF pilots will stay over 15 years in the Air Force. Unless we change our purpose (to secure air combat effective pilots), Care should be taken to ensure that pilot morale is not lowered by work loads in excess of air combat relevant duties. In the USAF case, a dissatisfaction with alerts, long crew duty days, and meaningless additional duties were pointed out as a reason for pilot attrition, and the USAF has had a serious pilot attrition problem due to these reasons [Ref. 30]. Therefore, Korean Air Force should take care to maintain the combat squadron tasked with only essential combat relevant duties in order to keep the pilots in a high state of combat readiness.

Finally, for a high combat readiness with well-trained combat pilots in Korean Air Force, we should try to maintain the maximum number of combat available pilots by a maximum 'cockpit only' policy and to seek an atmosphere in the combat squadron which focuses pilot attention on combat

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[8]Average age of IAF pilot in combat squadron is 25, a squadron commander is 30, and a wing commander is 37. Canopy Over Israel, 1982.

duties and maintenance of a high state of readiness. Since the pilot retention issue of KAF is not so serious due to the long obligation, the above considerations will be valuable fundamentals of KAF pilot management in terms of managing and maintaining the maximum available combat effective pilots.

## V. CONCLUSION AND RECOMMENDATION

The pilot combat effectiveness is as crucial to air combat readiness as air combat readiness is to national defense. The focus of this thesis has been the selection, training, and management of the combat effective pilot toward the maintenance of the KAF's maximum air combat readiness.

The significance of an air power in Korea is more critical than most other countries. In that a prepared decisive defense force is necessary to counter the high possibility of surprise intensive attack by a North Korean force which is within Air attack radius. A maximum air combat readiness is mandatory to repulse an attack in its initial stages. Unfortunately, the current efforts of the KAF to increase the level of an air combat readiness is not in keeping with its significance and North KAF's attack capability, despite a continuous modernization policy by the KAF. Korean research into analysis and development of air combat effectiveness factors is primitive, since KAF has been able to receive much information and data from the USAF. The special nature of the KAF dictates embarking on the our own research about the air combat effectiveness factors with KAF data applied KAF pilot quality control. The psychological characteristics data for the NPS sample pilots in Chapter IV might provide initial indications of a place to start improvement or specialized training efforts. The USAF's and other countries' research may be less meaningful in the different Korean social and military context. The magnitude of the problem may also be different with the number of KAF combat aircraft is over 500 (even though that number is still inferior to North KAF), and a need for approximately 1000 combat effective pilots. The quality level of those

KAF pilots will play a crucial role in national survivability.

It is essential for maximum pilot combat effectiveness that the KAF secure good pilot candidates, provide them more physical and psychological training at the Air Force Academy, employ specialized flight training, then keep them on a maximum "cockpit only" status with emphasis on Air-to-Air training and a traditional combat squadron's atmosphere. In order to assist the selection and training processes it is recommended that attention be paid to the two main predictors domains for an air combat effective pilot, psychological characteristics and special combat Skills. These factors with positive correlation to pilot effectiveness provide good guidance for pilot quality control. The significance of psychological characteristics is great since they have more influence than specific combat skills on air combat effectiveness, evidenced by the results of the McDonnell study [Ref. 14: p. 3-20].

The selection of combat effective pilots based on these criteria, should result in a higher victory probability as they are sent to initial air combat and as the KAF is able to maintain an increased level of air combat readiness. Research on these issues is required with reference to KAF pilot quality control using special research groups and analysis equipment, like the ACMR/I system.

Of course, emphasizing the points brought out in thesis concerning the achievement of maximum combat effectiveness, does not imply that there are no other relevant factors or intelligences. As Blankert's research in Chapter II indicates [Ref. 10: p. 43], we can expect the best results when a good pilot is combined with other superior physical systems (good weapon systems, aircraft, electronic warfare systems, etc). The electronic warfare ability is becoming more critical in an air combat as demonstrated in the 1986

USA-Libya conflict [Ref. 31: p. 17]. The USAF's 'Ready Pressure/High Flow G-suit' research[9] may have strong positive implications for KAF for air combat effectiveness. The KAF should be vigilant to any and all potential positive factors influencing air combat effectiveness.

Finally, the KAF, as a first priority, critically needs and relies on combat effective pilots for the maximum air combat readiness in support of national defense power. To promote air combat effectiveness the KAF should establish a special research group whose efforts would enhance KAF pilot quality control at all stages in the combat pilot career pipeline. An emphasis on research activity by the KAF will guarantee a more decisive role of the KAF in wartime as manifested by an increased air combat effectiveness.

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[9]USAF has been developing a ready pressure/ high flow G-suit that anticipates a high G maneuver and inflates before instead of during the turn or bank (this allows the pilot to withstand the higher force). Air Force, Jan 1986.

## APPENDIX A

## THE CURRENT STATUS OF USAF

| < ITEMS > | <FY'82> | <FY'83> | <FY'84> | <FY'85> | <FY'86> |
|---|---|---|---|---|---|
| 1. AF Military | | | | | |
| .Officers | 102,000 | 104,600 | 106,200 | 108,200 | 109,600 |
| .Airmen | 476,000 | 483,000 | 486,400 | 489,500 | 497,400 |
| .Cadet | 4,000 | 4,500 | 4,500 | 4,400 | 4,400 |
| TOTAL | 582,000 | 592,100 | 597,100 | 602,100 | 611,500 |
| 2. AF Budget Outlays | | | | | |
| .Current Dollars | $55,104 | $62,894 | $68,620 | $83,435 | *94,011 |
| .Constant FY'86 Dollars | $64,126 | $70,178 | $74,089 | $86,868 | $94,011 |
| | | | (millions of dollars) | | |
| .AF percent of: GNP | 1.8% | 2.0% | 1.9% | 2.2% | 2.2% |
| DOD Budget | 30.1% | 30.7% | 31.1% | 33.9% | 33.9% |
| 3. Type of Aircraft | | | | | |
| .Tanker | 542 | 546 | 556 | 561 | 573 |
| .Fighter/Attack/Interceptor | 2,900 | 2,997 | 3,019 | 3,048 | 3,037 |
| .Recon'/Electronic Warfare | 363 | 385 | 404 | 424 | 425 |
| .Cargo/Transport | 825 | 827 | 863 | 863 | 869 |
| .Other | 2,489 | 2,439 | 2,413 | 2,437 | 2,337 |
| TOTAL | 7,119 | 7,194 | 7,255 | 7,333 | 7,341 |

Figure A.1 USAF Expansion Status.

## APPENDIX B

## PREDICTORS OF A COMBAT EFFECTIVE PILOT

| Characteristics & Critical Skills | Not Recommended for Testing | Tested by USAF | Not Tested by USAF |
|---|---|---|---|
| **BIOGRAPHICAL DATA** | | | |
| . life inventory | | | * |
| . academic history | | * | |
| . military history | | * | |
| . military rank | | * | |
| **RISK TAKING** | | | |
| . willingness to take calculated risks | | | * |
| **REACTIONS TO STRESS** | | | |
| . performance under stress | | | * |
| . emotional control | | | * |
| . ability to withstand psychological stress | | | * |
| . anxiety | | | * |
| **SENSORY-MOTOR ABILITIES** | | | |
| . visual perception | | | * |
| . motor coordination | | | * |
| . spatial orientation | | | * |
| . spatial perceptual-ability | | | * |
| . perceptual speed | | | * |
| **APTITUDE** | | | |
| . pilot composites | | | * |
| . non pilot composites | | * | |
| . general aptitude (intelligence) | | * | |
| . numerical skills | | * | |
| . verval skills | | * | |
| . mechanical skills | | * | |
| . flight aptitude | | | * |
| **MOTIVATION** | | | |
| . determination/desire | | | * |
| . self discipline | | | * |
| . satisfaction | | | * |
| **AVIATOR SKILLS, KNOWLEDGES, AND TASKS** | | | |
| . equipment knowledge | | | * |
| . flight skills | | | * |
| . instrument reading | | | * |
| . aerial gunnery | | | * |

Figure B.1 Predictors of a Combat Effective Pilot.

Figure O
PREDICTORS (cont'd.)

| Characteristics & Critical Skills | Not Recommended for Testing | Tested by USAF | Not Tested by USAF |
|---|---|---|---|
| PERSONALITY | | | |
| . aggressiveness | | | * |
| . self conficence | | | * |
| . mental health | | * | |
| . consideration for others | * | | |
| . personality style | | | * |
| . courage | | | * |
| PERSONALITY-LEADERSHIP | | | |
| . responsibility for men in combat | | | * |
| . physical/combat leadership | * | | |
| . administrative skills | * | | |
| . military bearing | | | |
| SOCIAL FACTORS | | | |
| . teamwork | | | * |
| . sociability | | | * |
| . group loyalty | * | | |
| . interpersonal ratings | | | * |
| MEDICAL/PHYSIOLOGICAL | | | |
| . good physical health | | * | |
| . endurance | * | | |
| . physical aptitude | * | | |
| . ability to withstand physiological stress | | | * |
| DECISION MAKING/ INFORMATION PROCESSING | | | |
| . selective attention | | | * |
| . decision time | | | * |
| . quality of combat decision | | | * |
| . alertness | | | * |
| . integrative decision | | | * |

# APPENDIX C

## IAF COMBAT PILOT TRAINING PIPELINE

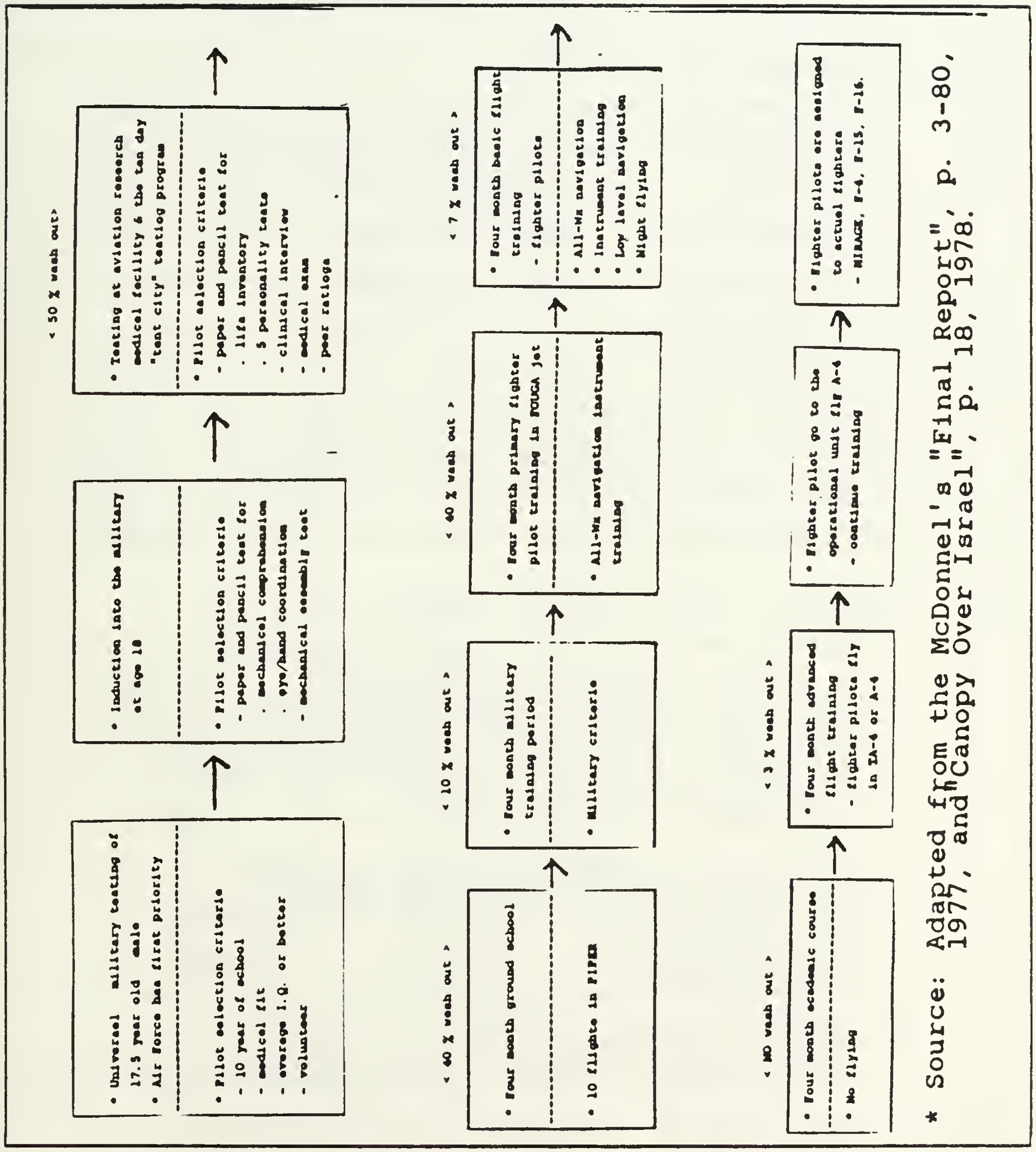


Figure C.1 IAF Combat Pilot Training Pipeline.

# APPENDIX D

## NPS KOREAN PILOT SURVEY FORM

1. Personal characteristics
   1) Desire to achieve ------------------------------ (    )
   2) Initiative ------------------------------------- (    )
   3) Courage ---------------------------------------- (    )
   4) Psychological stress tolerence ----------------- (    )
   5) physiological stress tolerence ----------------- (    )
   6) Determination ---------------------------------- (    )
   8) Willingness to take risk ----------------------- (    )
   9) Anxiety tolerence ------------------------------ (    )
   10) team cooperativeness -------------------------- (    )
   11) Endurance ------------------------------------- (    )
   12) Leadership ------------------------------------ (    )

2. Special Combat Skills (Ability to: )
   1) Obtain early visual target acquisition. ----- (    )
   2) Perceive/judge target direction & -------- (    )
      turn rate, aspect angle, angle off...so on.
   3) Keep track of critical flight parameter ----- (    )
      (SPD, ATT, ALT, angle of attack, 'G'...)
   4) Select and executive the best maneuver ------ (    )
      to gain a firing position.
   5) Judge when to shoot. ------------------------ (    )
   6) Shoot well ( both tracking, or raking ------- (    )
      shot when tracking was impossible ).
   7) Handle the throttle(s) and speed brake ------ (    )
      (manage energe).
   8) Keep track of the other guys - wing man, ---- (    )
      other hostiles.
   9) Judge when to leave the fight. -------------- (    )

   ** JUDGE yourself on a scale of 1 to 9
   ** SCALE characteristics: 5 is average,
   lower number is poor, higher number is outstanding

Figure D.1 NPS Korean Pilot Survey Form.

# APPENDIX E

## THE RESULTS OF 'LOTUS 1.2.3' MODEL

### 1. VARIABLES AND RELATIVE WEIGHTS

| VARIABLE | % RESPONDING CRITICAL | NORMALIZED WEIGHT |
|---|---|---|
| PERSONNAL CHARACTERISTICS | | 0.5 |
| AGRESSIVENESS | 46.4 | 0.132306 |
| DESIRE TO ACHIEVE | 43.3 | 0.123467 |
| DETERMINATION | 41.9 | 0.119475 |
| WILLINGNESS TO TAKE RISK | 33.4 | 0.095238 |
| INITIATIVE | 33.3 | 0.094952 |
| COURAGE | 32.6 | 0.092956 |
| PSYCHOLOGICAL STRESS TOLERANCE | 27.5 | 0.078414 |
| ANXIETY TOLERANCE | 22.2 | 0.063301 |
| PHYSIOLOGICAL STRESS TOLERANCE | 21.1 | 0.060165 |
| TEAM COOPERATIVENESS | 17.5 | 0.049900 |
| LEADERSHIP | 16.7 | 0.047619 |
| ENDURANCE | 14.8 | 0.042201 |
| SUM | 350.7 | 1 |
| COMBAT SKILLS | | 0.5 |
| EARLY VISUAL TARGET ACQUISITION | -- | 0.2 |
| SELECT/EXECUTE BEST MANEUVER | -- | 0.2 |
| PERCEIVE/JUDGE TARGET VECTOR | -- | 0.2 |
| JUDGE WHEN TO SHOOT | -- | 0.2 |
| KEEP TRACK OF THE OTHER GUYS | -- | 0.2 |
| | SUM | 1 |

Figure E.1 Survey Variables and Relative Weights.

## 2. SELF-REPORT DATA

| PILOT 1 | WxR | PILOT 2 | WxR | PILOT 3 | WxR | PILOT 4 | WxR |
|---|---|---|---|---|---|---|---|
| 6.290276 | 3.145138 | 8.010550 | 4.005275 | 6.939834 | 3.469917 | 7.092956 | 3.546478 |
| 5 | 0.661534 | 8 | 1.058454 | 6 | 0.793840 | 7 | 0.926147 |
| 7 | 0.864271 | 9 | 1.111206 | 7 | 0.864271 | 7 | 0.864271 |
| 7 | 0.836327 | 8 | 0.955802 | 7 | 0.836327 | 7 | 0.836327 |
| 6 | 0.571428 | 8 | 0.761904 | 6 | 0.571428 | 7 | 0.666666 |
| 6 | 0.569717 | 9 | 0.854576 | 7 | 0.664670 | 7 | 0.664670 |
| 7 | 0.650698 | 9 | 0.836612 | 7 | 0.650698 | 8 | 0.743655 |
| 6 | 0.470487 | 5 | 0.392072 | 8 | 0.627316 | 7 | 0.548902 |
| 6 | 0.379811 | 8 | 0.506415 | 6 | 0.379811 | 7 | 0.443113 |
| 6 | 0.360992 | 7 | 0.421157 | 8 | 0.481323 | 7 | 0.421157 |
| 7 | 0.349301 | 8 | 0.399201 | 8 | 0.399201 | 7 | 0.349301 |
| 5 | 0.238095 | 7 | 0.333333 | 7 | 0.333333 | 7 | 0.333333 |
| 8 | 0.337610 | 9 | 0.379811 | 8 | 0.337610 | 7 | 0.295409 |
| 6.4 | 3.2 | 7.6 | 3.8 | 4.6 | 2.3 | 6.2 | 3.1 |
| 6 | 1.2 | 5 | 1 | 5 | 1 | 7 | 1.4 |
| 6 | 1.2 | 8 | 1.6 | 4 | 0.8 | 6 | 1.2 |
| 7 | 1.4 | 8 | 1.6 | 4 | 0.8 | 5 | 1 |
| 5 | 1 | 8 | 1.6 | 5 | 1 | 7 | 1.4 |
| 8 | 1.6 | 9 | 1.8 | 5 | 1 | 6 | 1.2 |
| MODEL SUM | 6.345138 | | 7.805275 | | 5.769917 | | 6.646478 |

Figure E.2 Self Report Data.

Figure 0
SELF REPORT DATA (cont'd.)

| PILOT 5 | WxR | PILOT 6 | WxR | PILOT 7 | WxR | PILOT 8 | WxR |
|---|---|---|---|---|---|---|---|
| 4.972341 | 2.486170 | 5.960650 | 2.980325 | 6.380667 | 3.190333 | 6.364699 | 3.182349 |
| 4 | 0.529227 | 7 | 0.926147 | 8 | 1.058454 | 7 | 0.926147 |
| 7 | 0.864271 | 6 | 0.740804 | 8 | 0.987738 | 7 | 0.864271 |
| 3 | 0.358426 | 5 | 0.597376 | 7 | 0.836327 | 6 | 0.716852 |
| 4 | 0.380952 | 5 | 0.476190 | 3 | 0.285714 | 7 | 0.666666 |
| 6 | 0.569717 | 6 | 0.569717 | 5 | 0.474764 | 6 | 0.569717 |
| 5 | 0.464784 | 7 | 0.650698 | 5 | 0.464784 | 6 | 0.557741 |
| 5 | 0.392072 | 6 | 0.470487 | 6 | 0.470487 | 5 | 0.392072 |
| 5 | 0.316509 | 6 | 0.379811 | 7 | 0.443113 | 6 | 0.379811 |
| 6 | 0.360992 | 6 | 0.360992 | 7 | 0.421157 | 6 | 0.360992 |
| 5 | 0.249500 | 5 | 0.249500 | 8 | 0.399201 | 7 | 0.349301 |
| 4 | 0.190476 | 6 | 0.285714 | 6 | 0.285714 | 6 | 0.285714 |
| 7 | 0.295409 | 6 | 0.253207 | 6 | 0.253207 | 7 | 0.295409 |
| | | | | | | 6.333333 | |
| 5 | 2.5 | 5.6 | 2.8 | 5.2 | 2.6 | 6.4 | 3.2 |
| 5 | 1 | 6 | 1.2 | 3 | 0.6 | 7 | 1.4 |
| 7 | 1.4 | 7 | 1.4 | 7 | 1.4 | 6 | 1.2 |
| 6 | 1.2 | 5 | 1 | 4 | 0.8 | 6 | 1.2 |
| 3 | 0.6 | 5 | 1 | 5 | 1 | 6 | 1.2 |
| 4 | 0.8 | 5 | 1 | 7 | 1.4 | 7 | 1.4 |
| | 4.986170 | | 5.780325 | | 5.790333 | | 6.382349 |

Figure 0
SELF REPORT DATA (cont'd.)

| PILOT 9 | WxR | PILOT 10 | WxR | PILOT 11 | WxR | PILOT 12 | WxR |
|---|---|---|---|---|---|---|---|
| 6.685771 | 3.342885 | 7.030510 | 3.515255 | 7.339321 | 3.669660 | 7.631879 | 3.815939 |
| 7 | 0.926147 | 8 | 1.058454 | 8 | 1.058454 | 7 | 0.926147 |
| 7 | 0.864271 | 8 | 0.987738 | 9 | 1.111206 | 8 | 0.987738 |
| 6 | 0.716852 | 6 | 0.716852 | 8 | 0.955802 | 6 | 0.716852 |
| 5 | 0.476190 | 8 | 0.761904 | 7 | 0.666666 | 8 | 0.761904 |
| 5 | 0.474764 | 5 | 0.474764 | 7 | 0.664670 | 9 | 0.854576 |
| 7 | 0.650698 | 8 | 0.743655 | 7 | 0.650698 | 8 | 0.743655 |
| 9 | 0.705731 | 8 | 0.627316 | 7 | 0.548902 | 7 | 0.548902 |
| 6 | 0.379811 | 7 | 0.443113 | 8 | 0.506415 | 7 | 0.443113 |
| 7 | 0.421157 | 8 | 0.481323 | 4 | 0.240661 | 8 | 0.481323 |
| 8 | 0.399201 | 5 | 0.249500 | 7 | 0.349301 | 9 | 0.449101 |
| 7 | 0.333333 | 4 | 0.190476 | 7 | 0.333333 | 8 | 0.380952 |
| 8 | 0.337610 | 7 | 0.295409 | 6 | 0.253207 | 8 | 0.337610 |
| 7.2 | 3.6 | 7 | 3.5 | 7.2 | 3.6 | 7.2 | 3.6 |
| 7 | 1.4 | 6 | 1.2 | 7 | 1.4 | 8 | 1.6 |
| 7 | 1.4 | 8 | 1.6 | 8 | 1.6 | 7 | 1.4 |
| 8 | 1.6 | 8 | 1.6 | 6 | 1.2 | 7 | 1.4 |
| 6 | 1.2 | 7 | 1.4 | 8 | 1.6 | 6 | 1.2 |
| 8 | 1.6 | 6 | 1.2 | 7 | 1.4 | 8 | 1.6 |
| | 6.942885 | | 7.015255 | | 7.269660 | | 7.415939 |

3. PSYCHOLOGICAL CHARACTERISTICS ANALYSIS

1. Aggressiveness

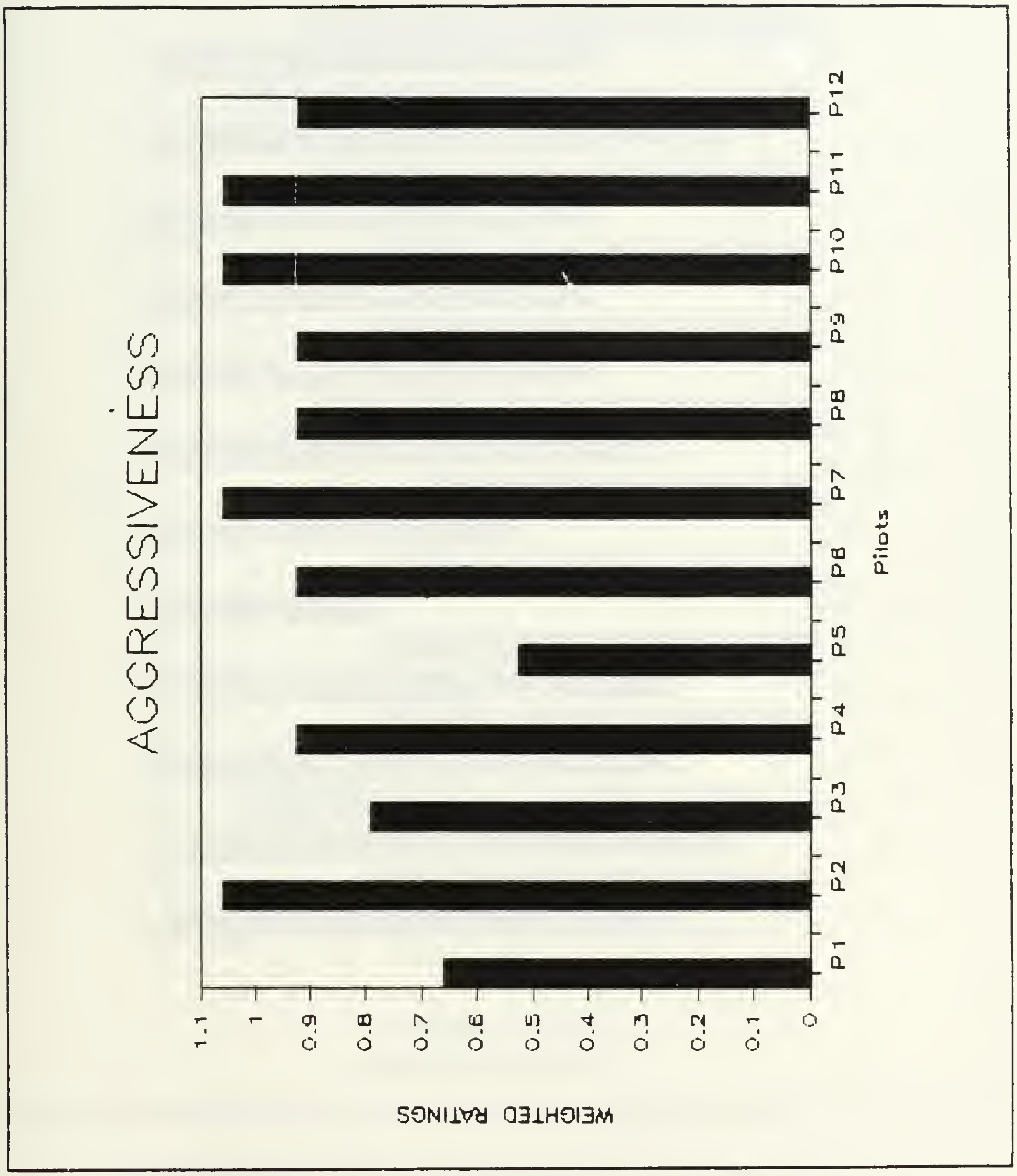


Figure E.3 Survey Results-Aggressiveness.

## 2. Determination

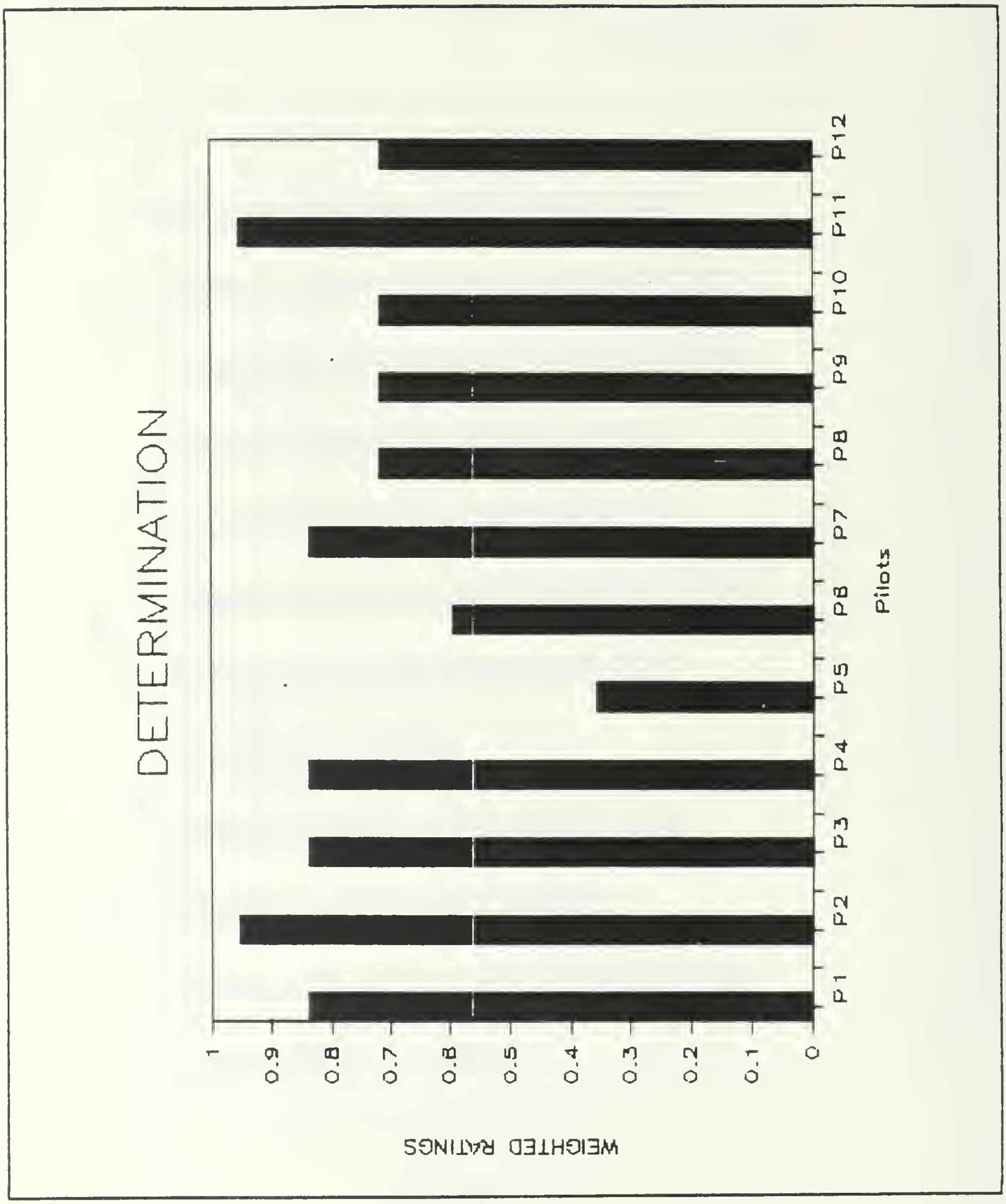


Figure E.4 Survey Results-Determination.

3. <u>Desire to Achieve</u>

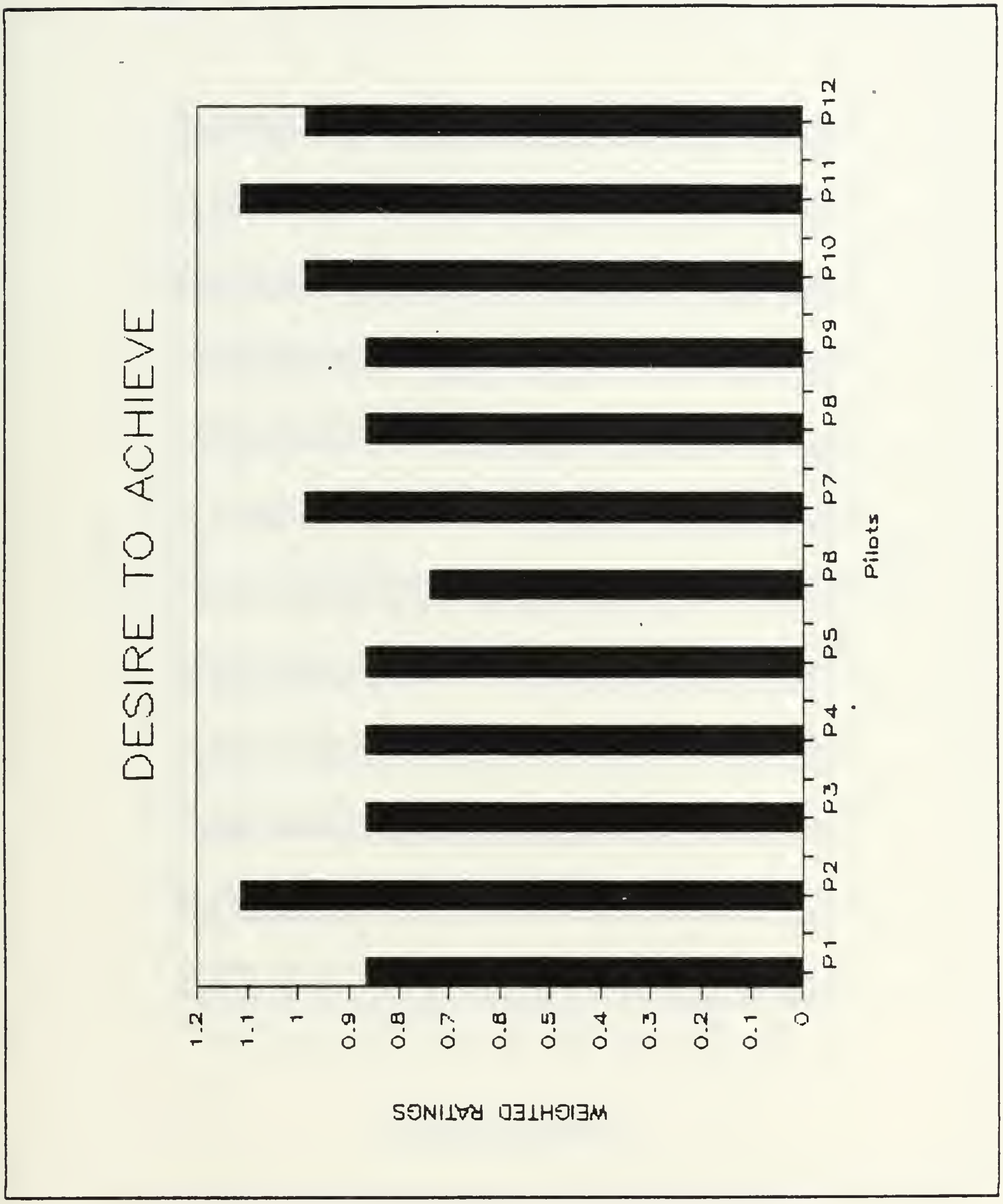


Figure E.5 Survey Results-Desire to Achieve.

4. Initiative

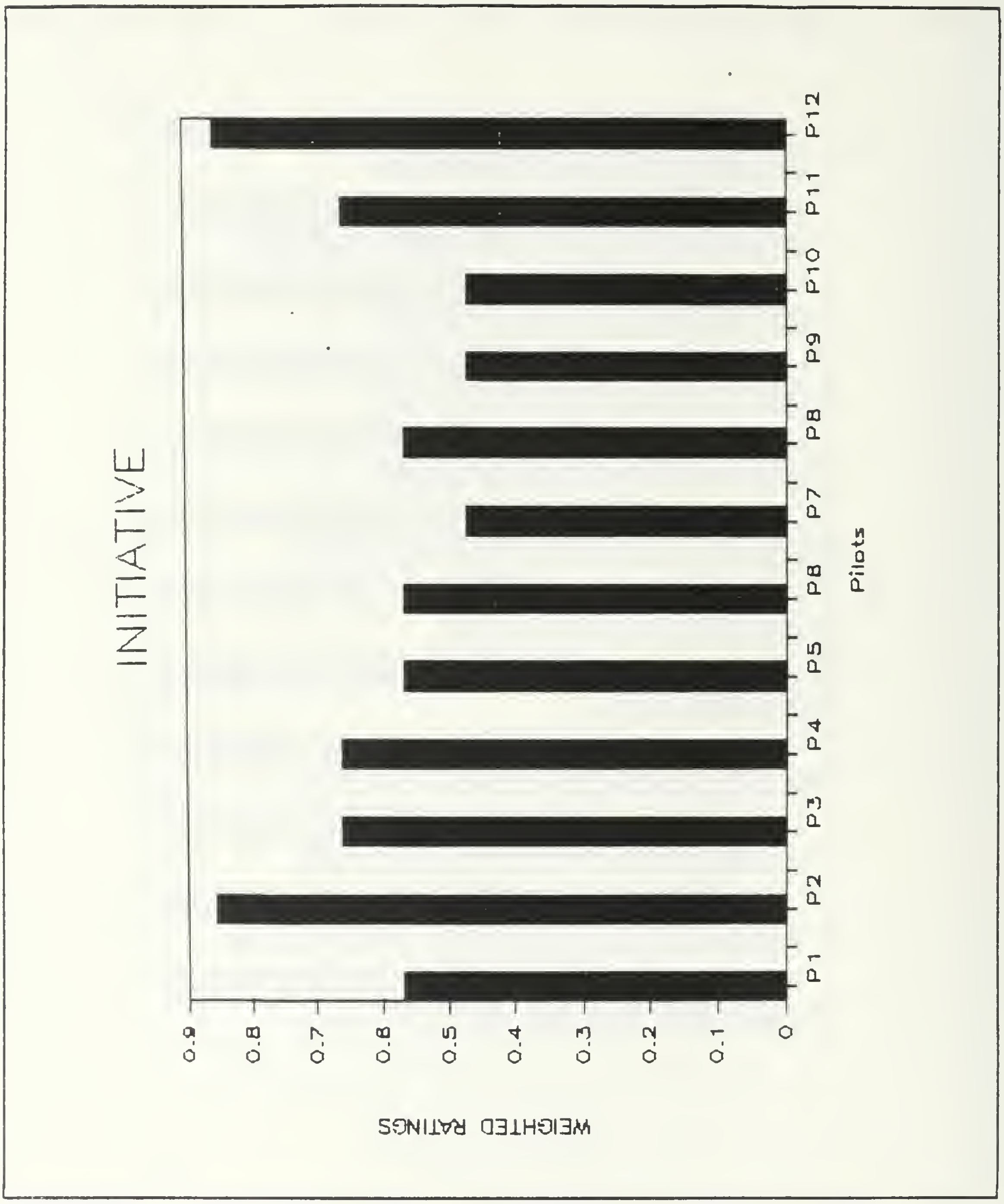


Figure E. 6 Survey Results-Initiative.

## 5. Courage

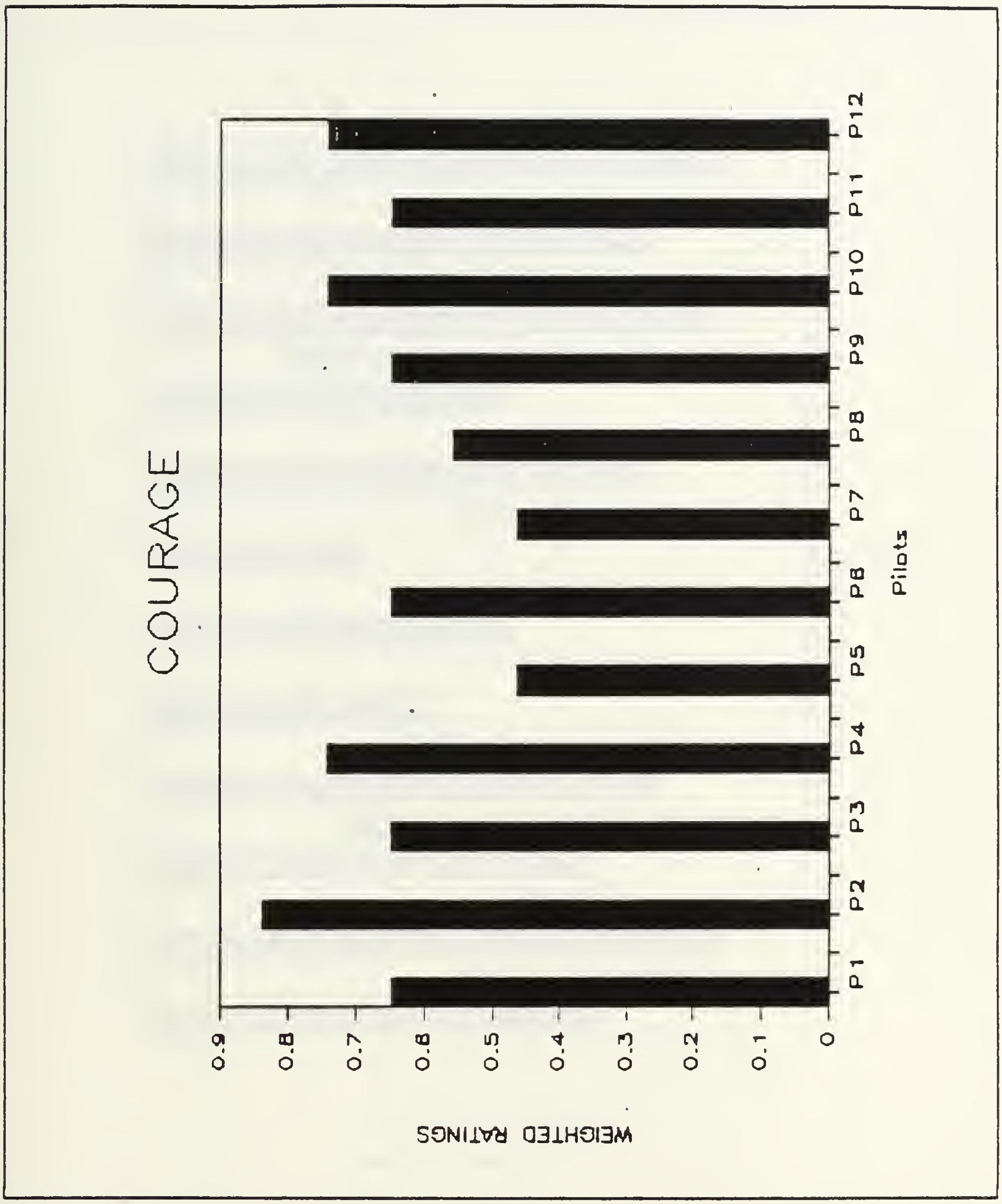


Figure E.7 Survey Results-Courage.

6. <u>Willingness to Take a Risk</u>

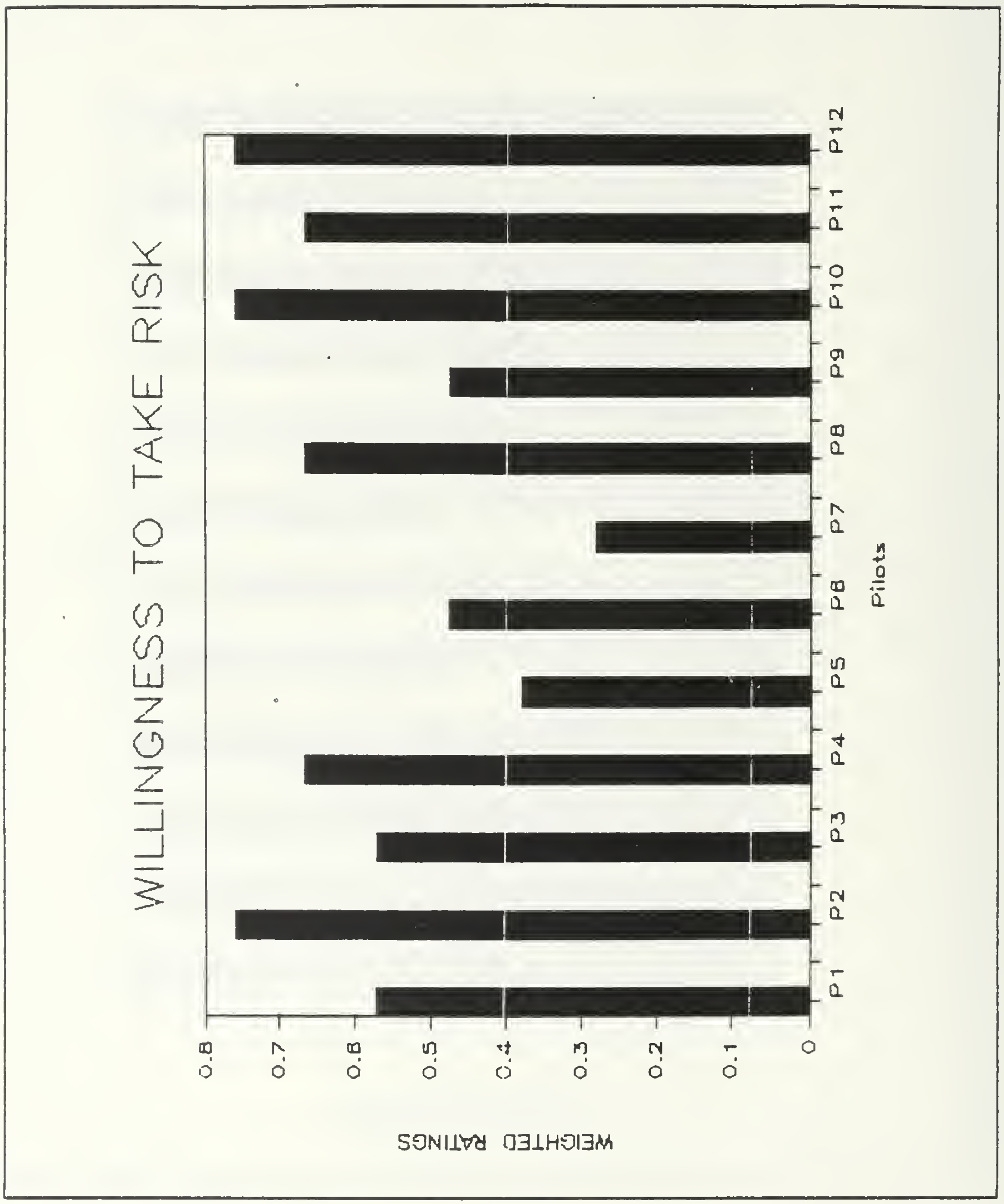


Figure E.8 Survey Results-Willingness to Take a Risk.

7. <u>Psychological Stress Tolerance</u>

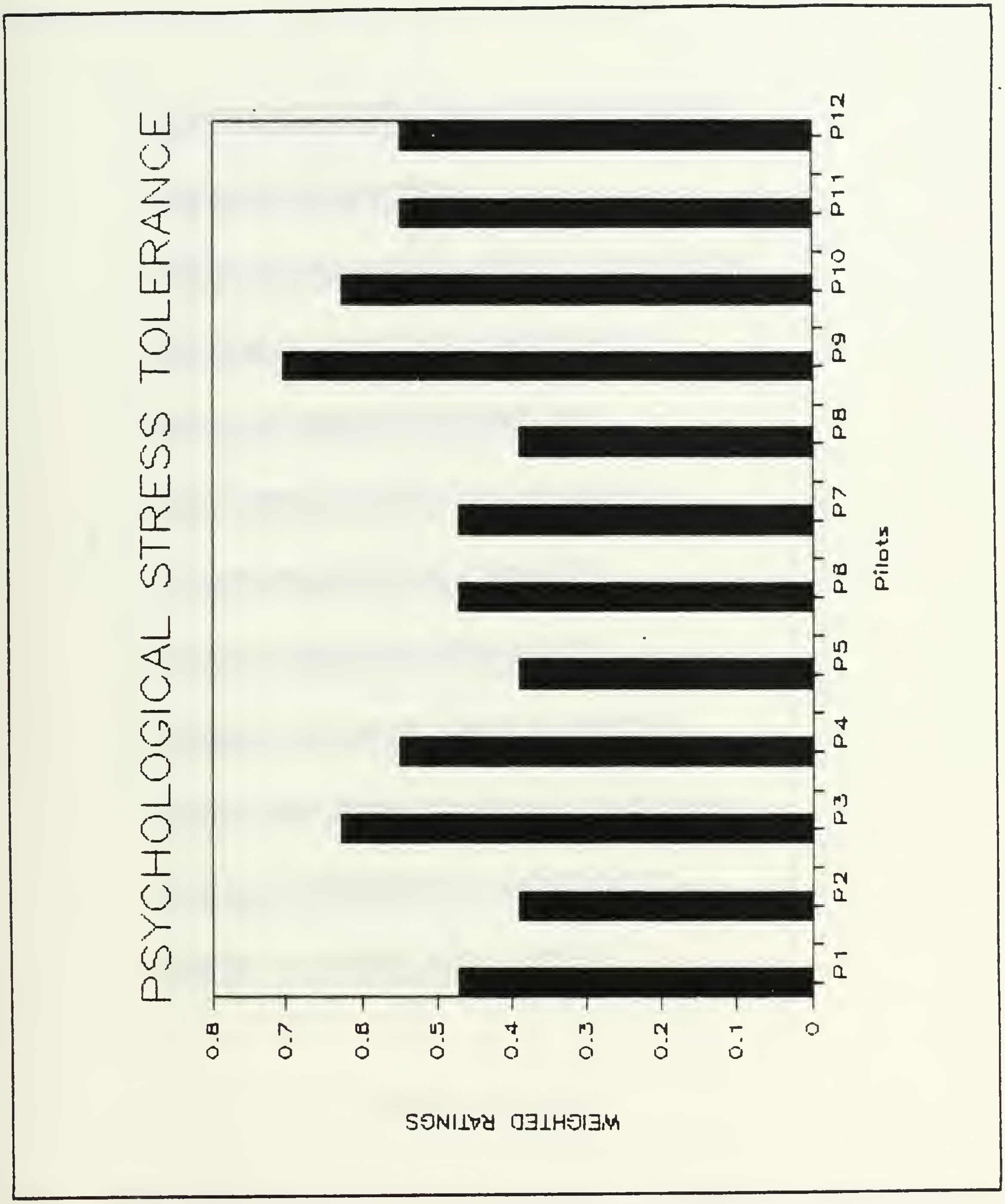


Figure E.9 Survey Results-Psychological Stress Tolerance.

8. <u>Physiological Stress Tolerance</u>

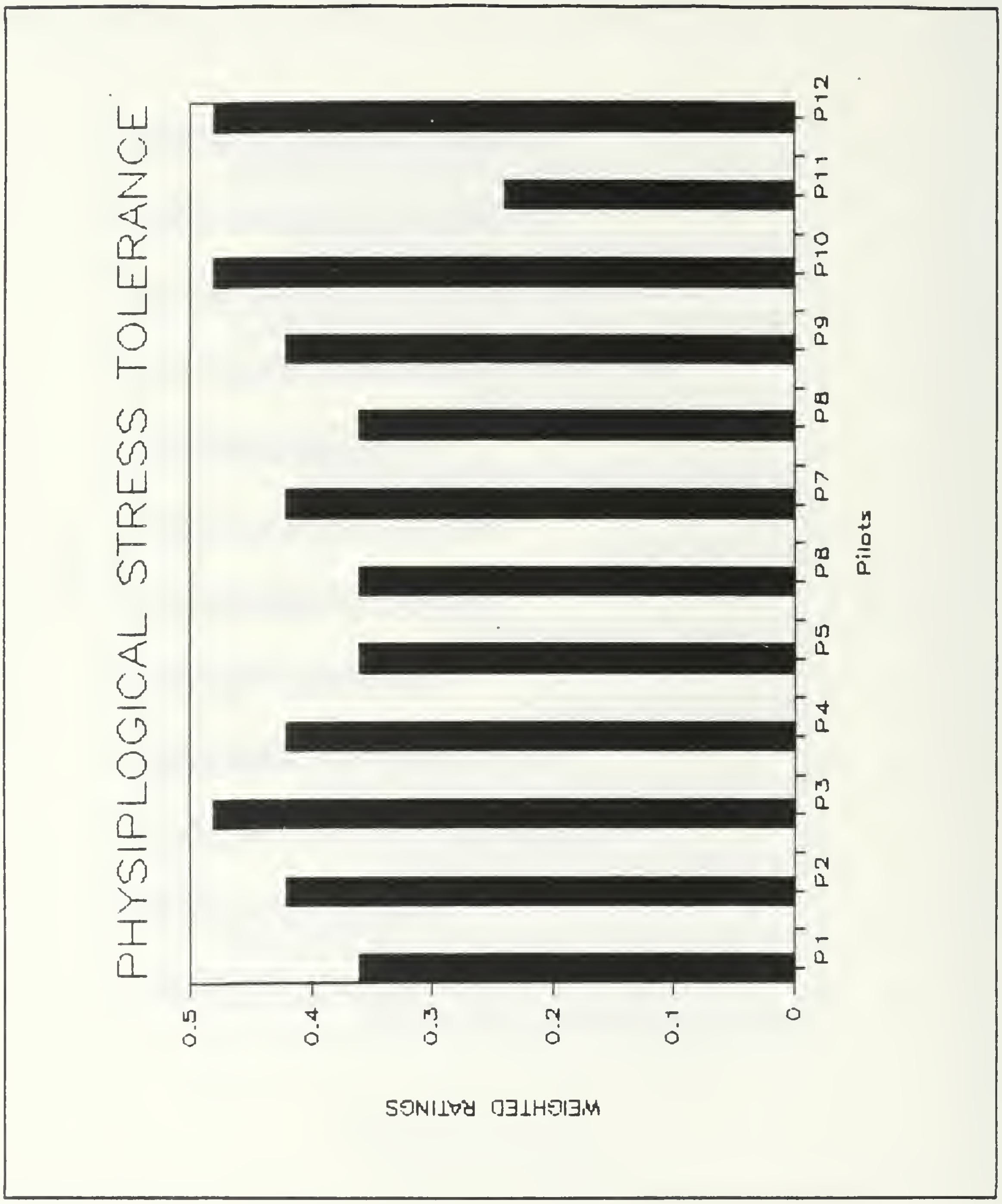


Figure E.10 Survey Results-Physiological Stress Tolerance.

9. Anxiety Tolerance

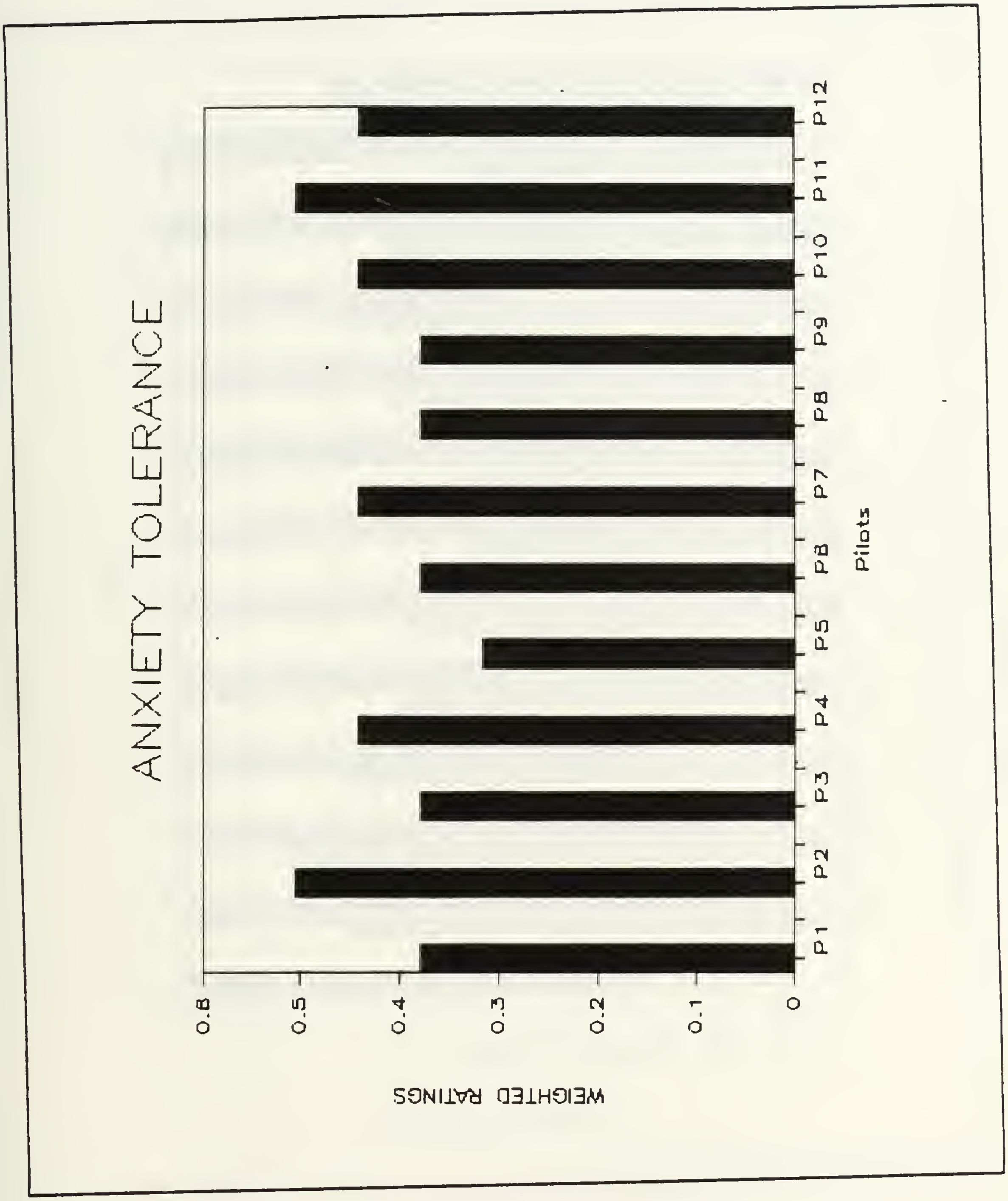


Figure E.1 Survey Results-Anxiety Tolerance.

10. Team Cooperativeness

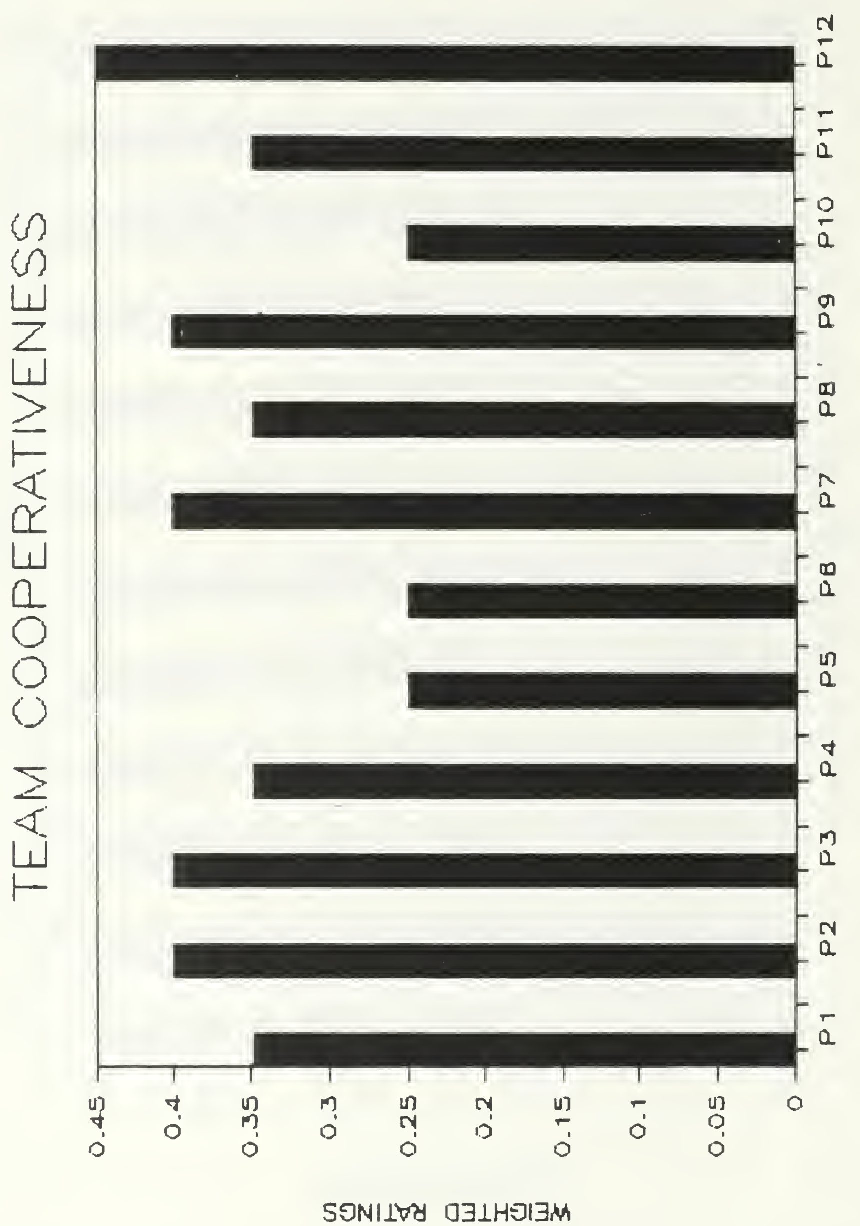


Figure E.2 Survey Results-Team Cooperativeness.

11. Endurance

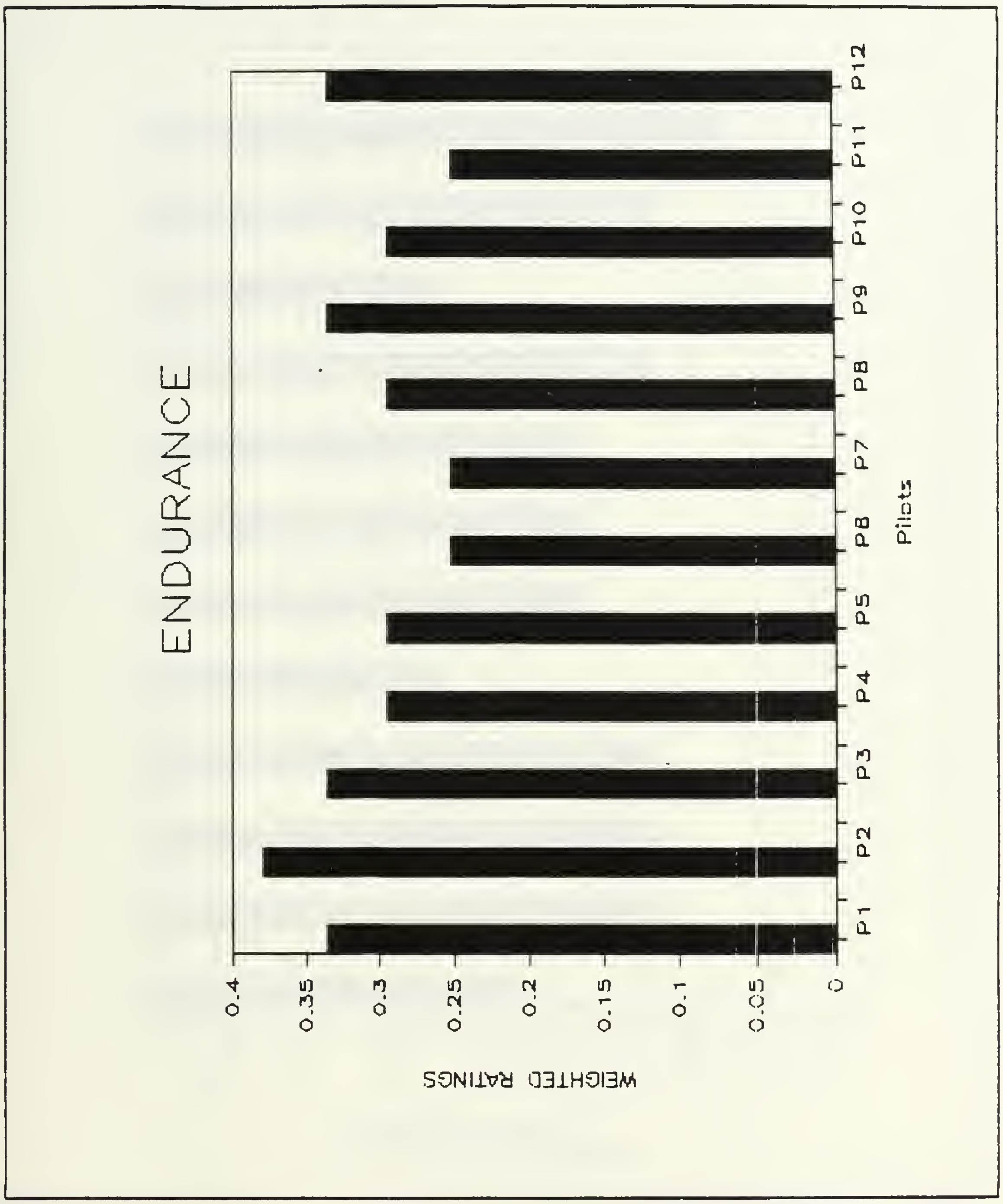


Figure E.11 Survey Results-Endurance.

12. Leadership

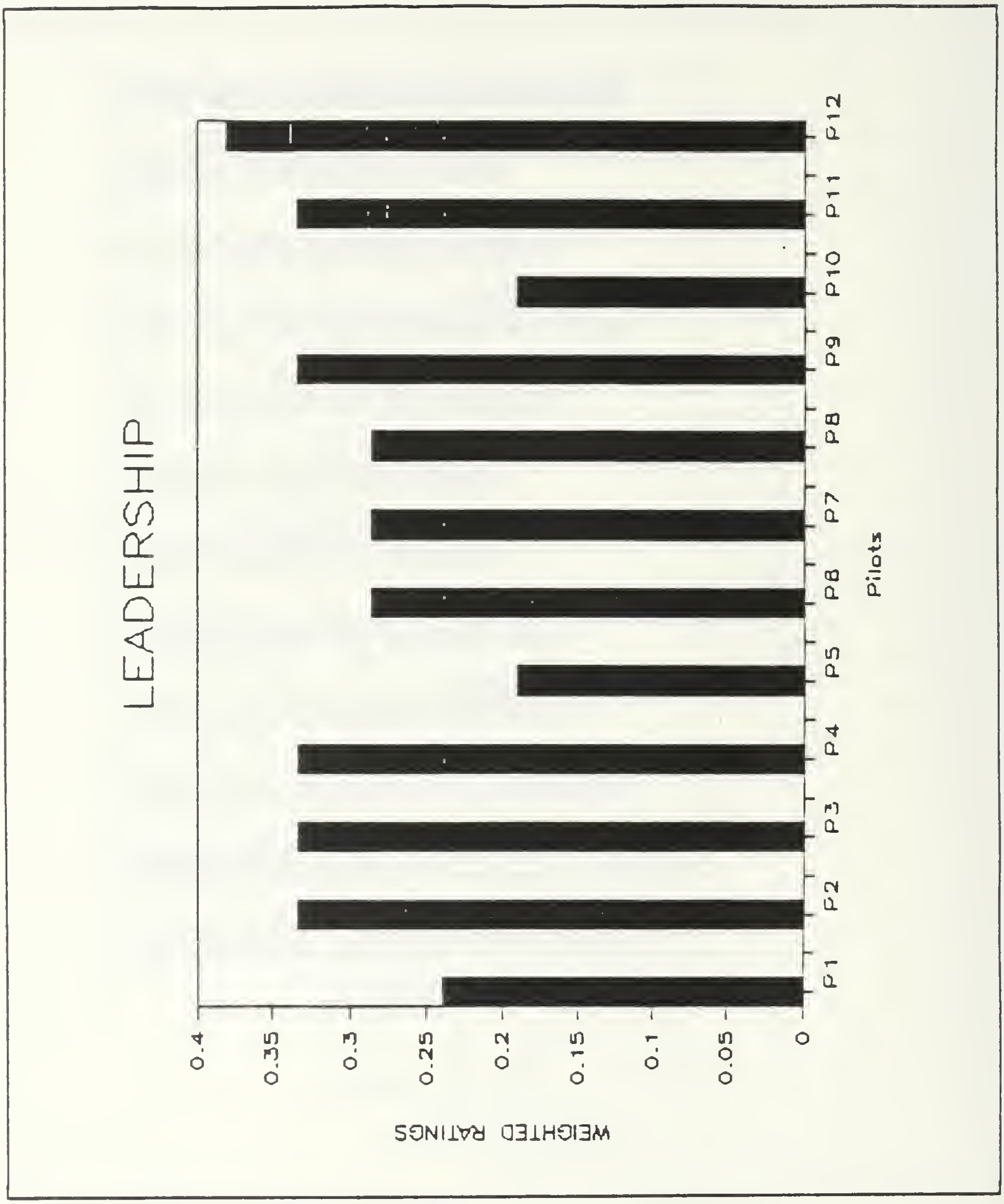


Figure E.12 Survey Results-Leadership.

4. INDIVIDUAL PILOT'S PSYCHOLOGICAL CHARACTERISTICS

1. <u>PILOT 1</u>

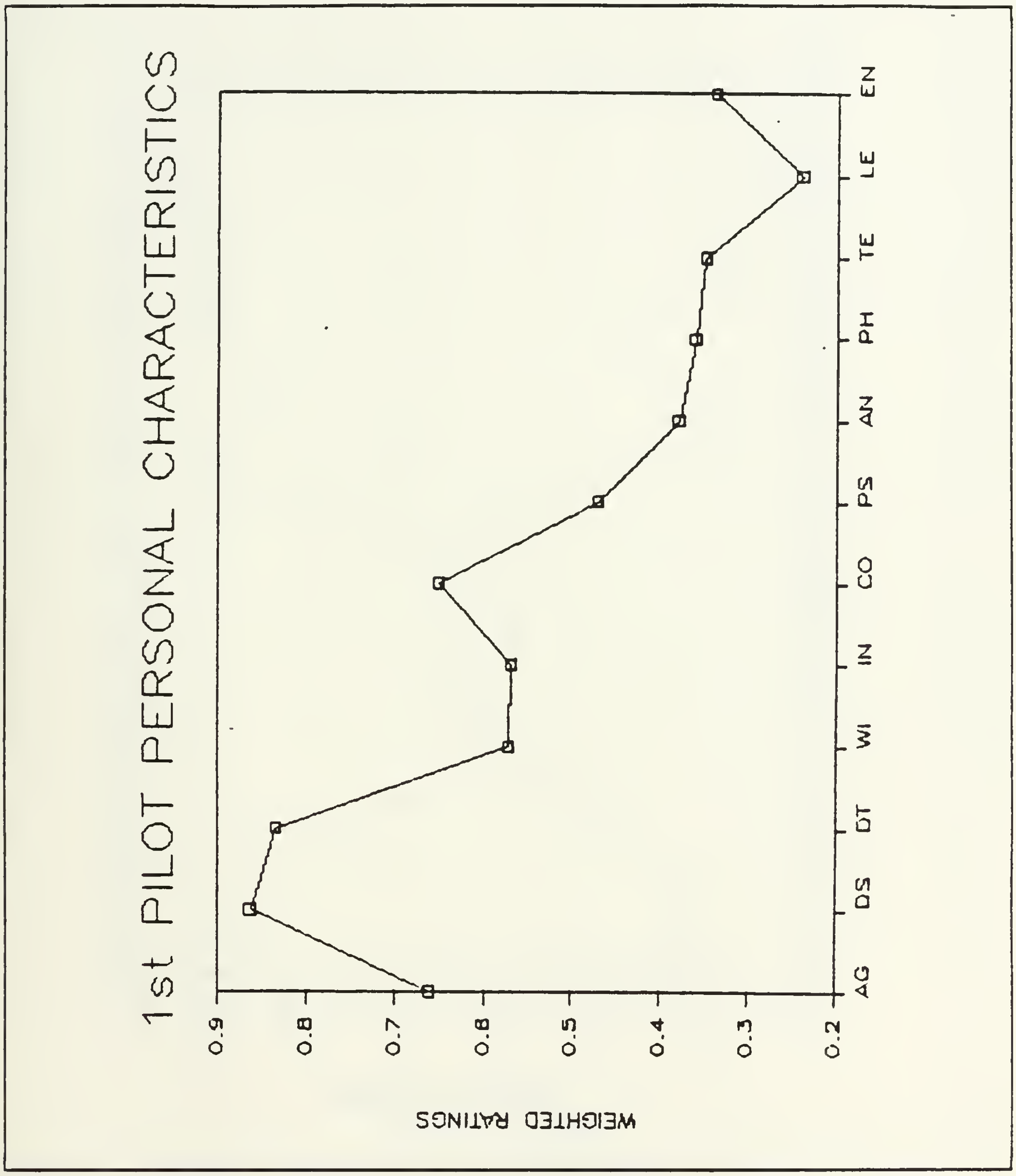


Figure E.13 Survey Results-Pilot 1.

2. PILOT 2

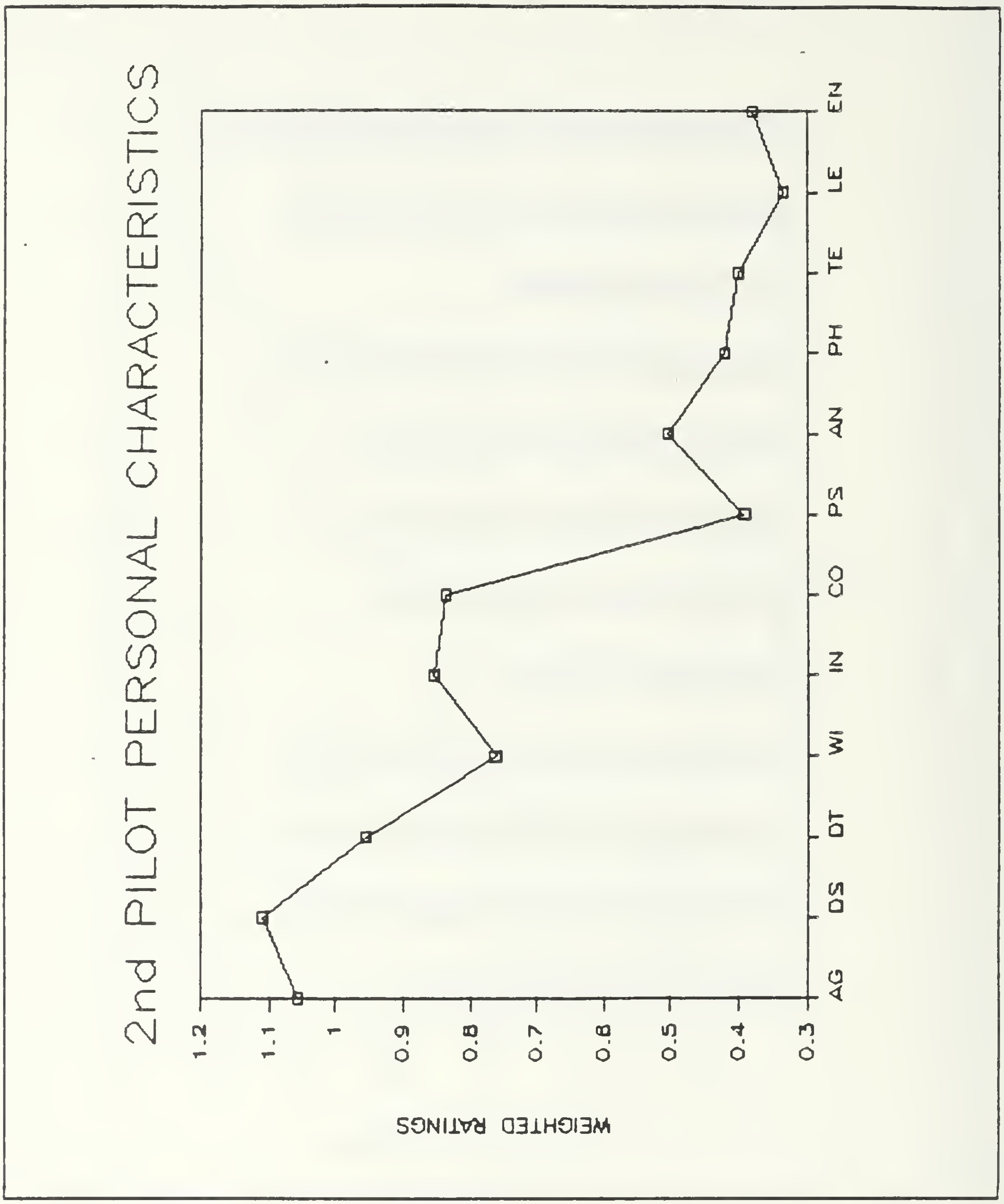


Figure E.14 Survey Results-Pilot 2.

3. PILOT 3

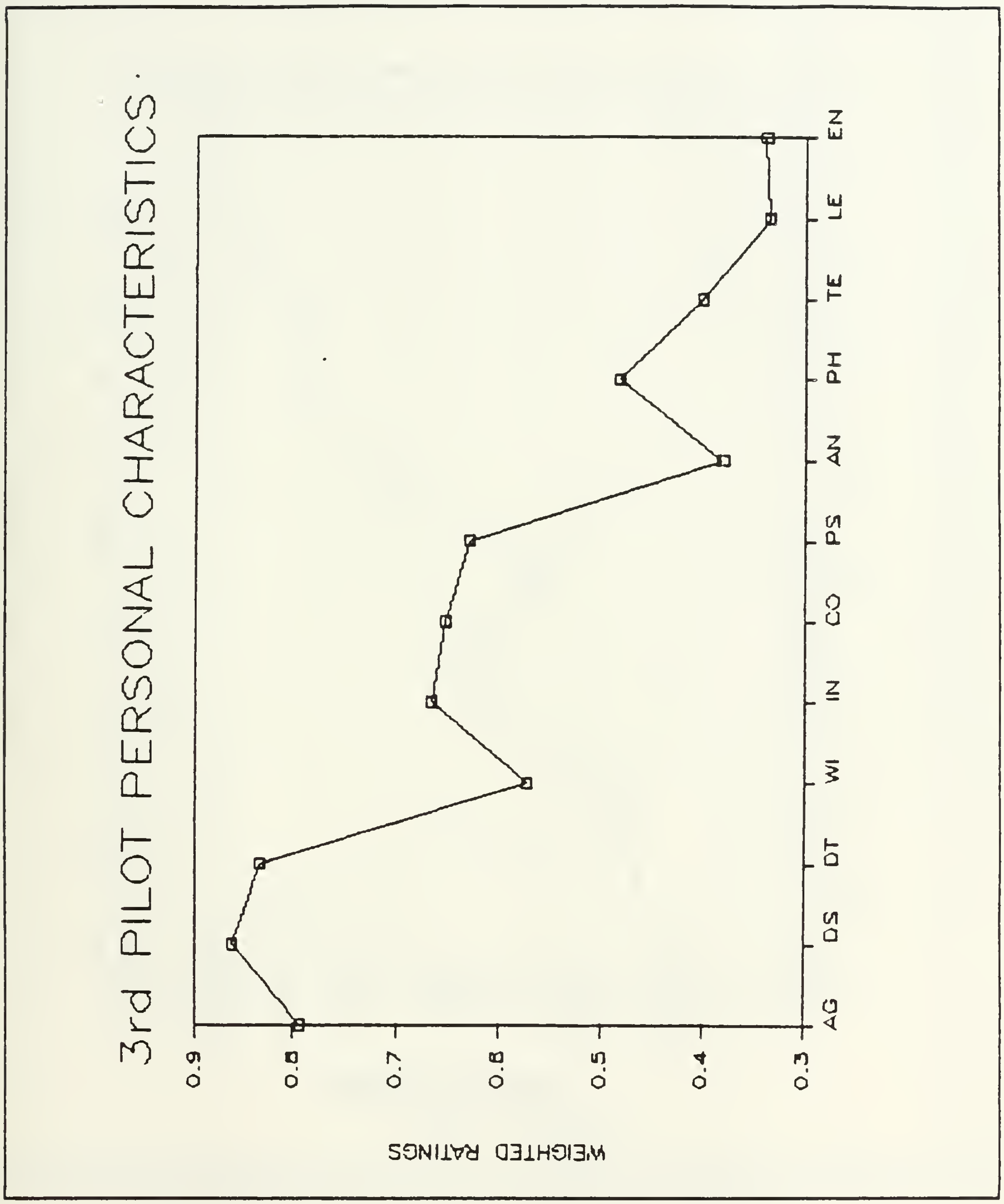


Figure E.15 Survey Results-Pilot 3.

4. PILOT 4

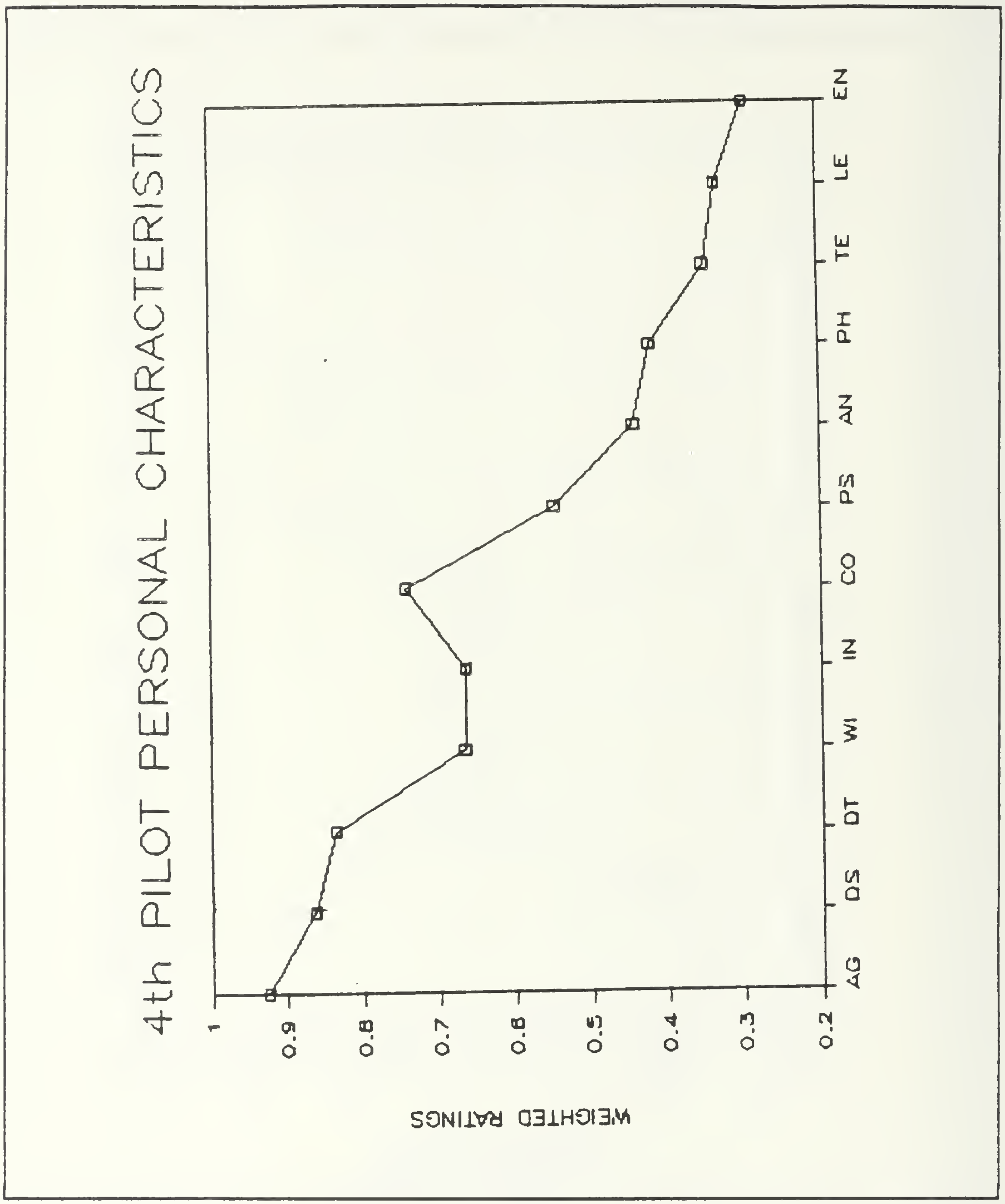


Figure E.16 Survey Results-Pilot 4.

5. PILOT 5

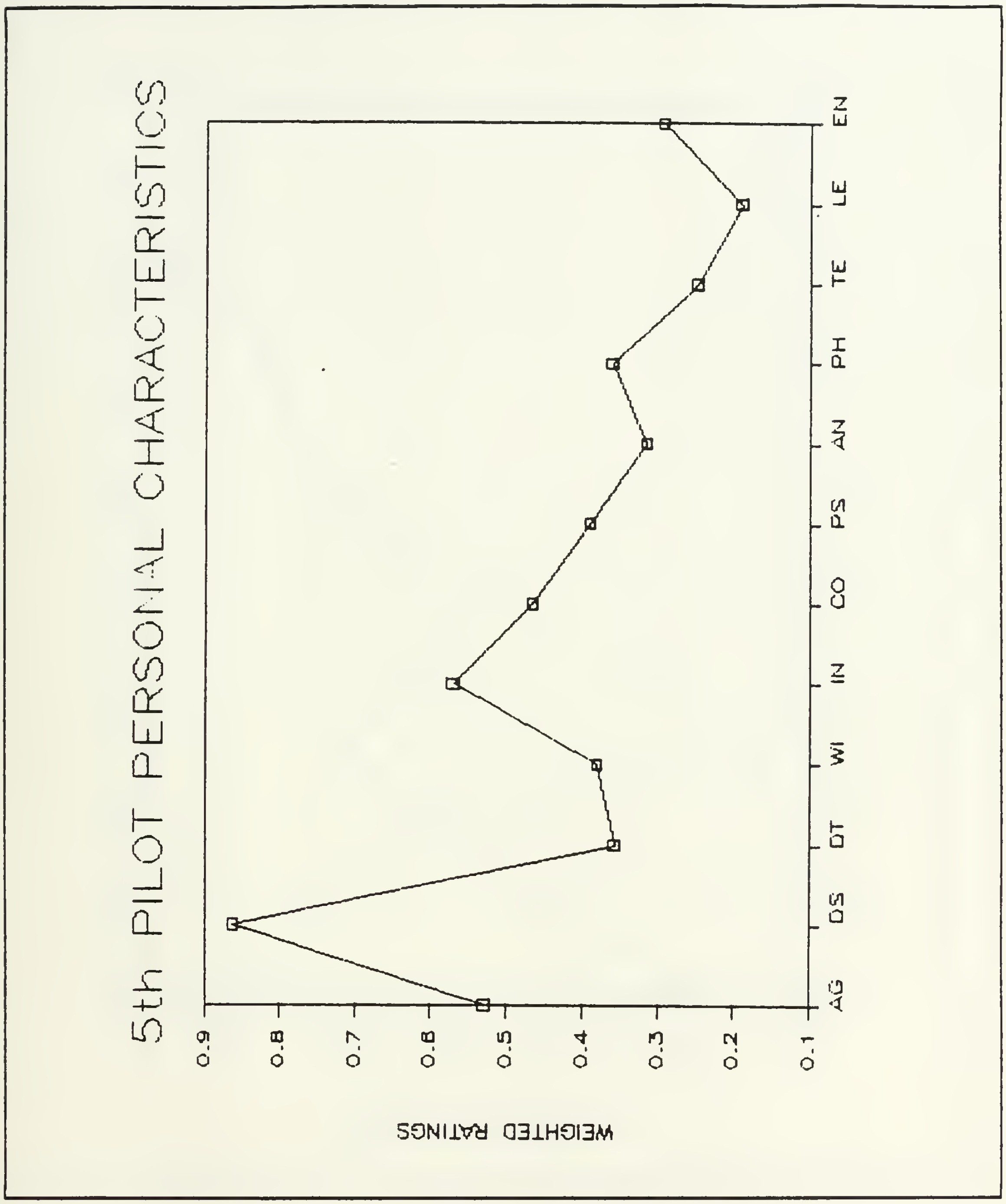


Figure E.17 Survey Results-Pilot 5.

## 6. PILOT 6

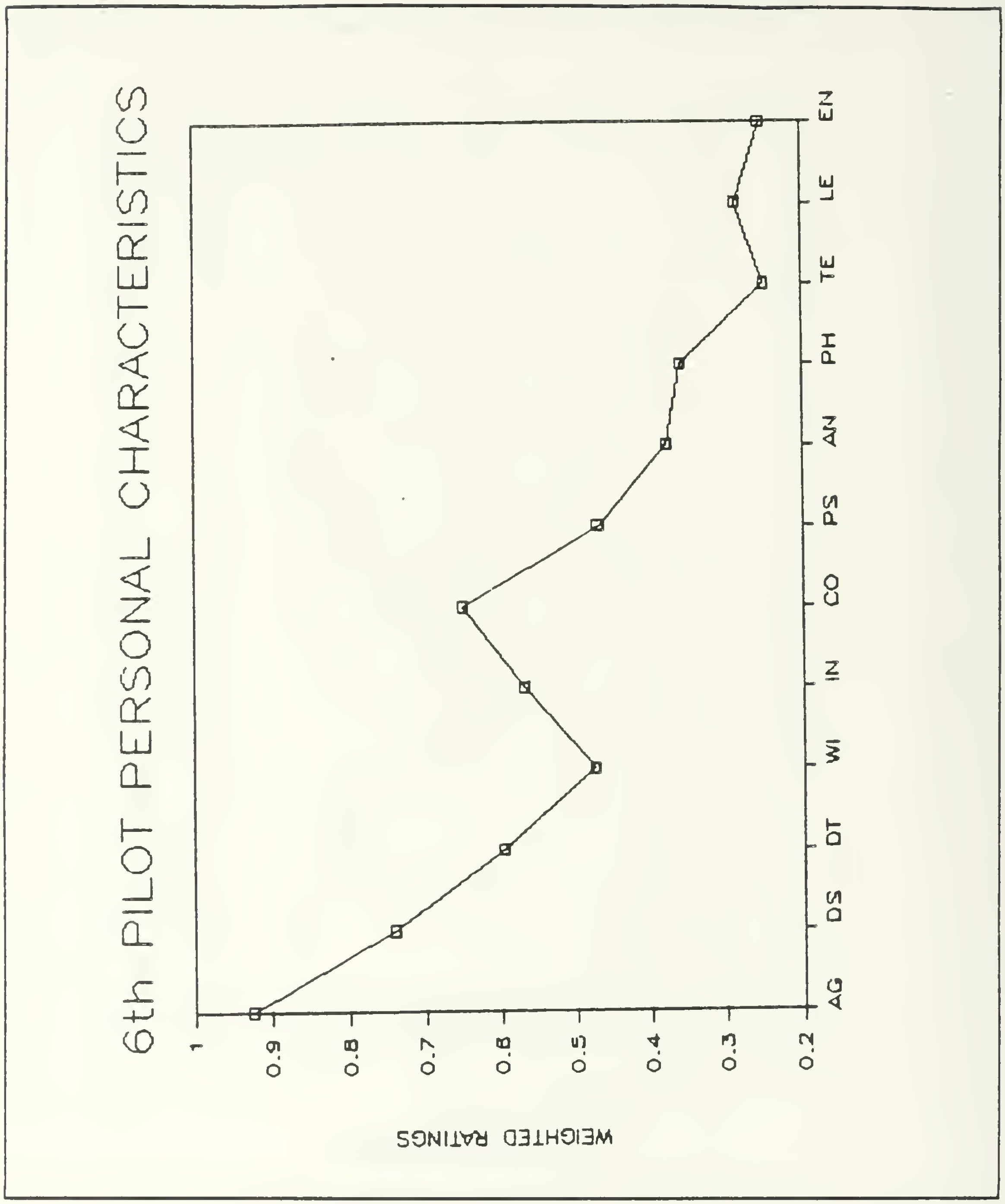


Figure E.18 Survey Results-Pilot 6.

7. PILOT 7

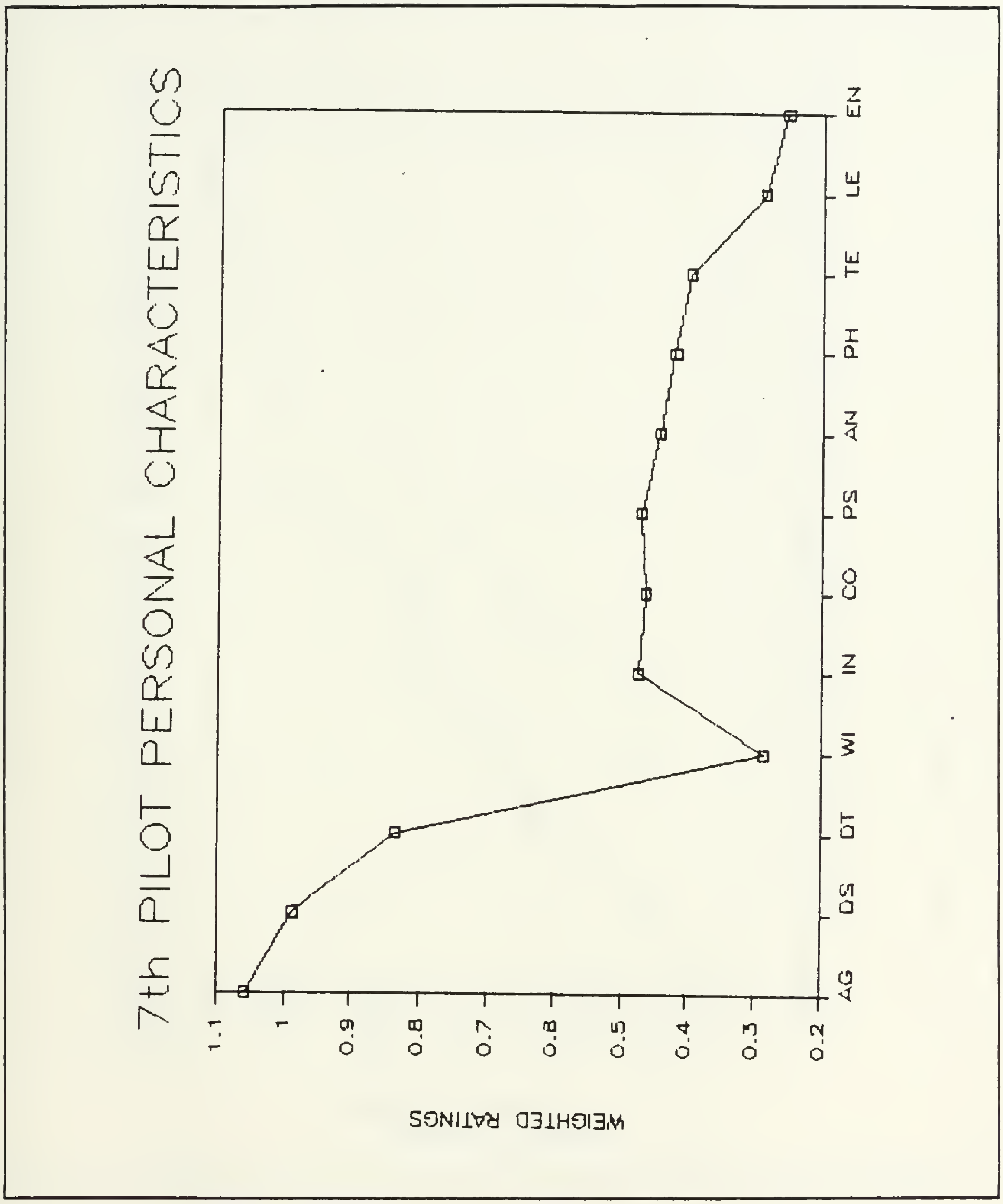


Figure E.19 Survey Results-Pilot 7.

8. PILOT 8

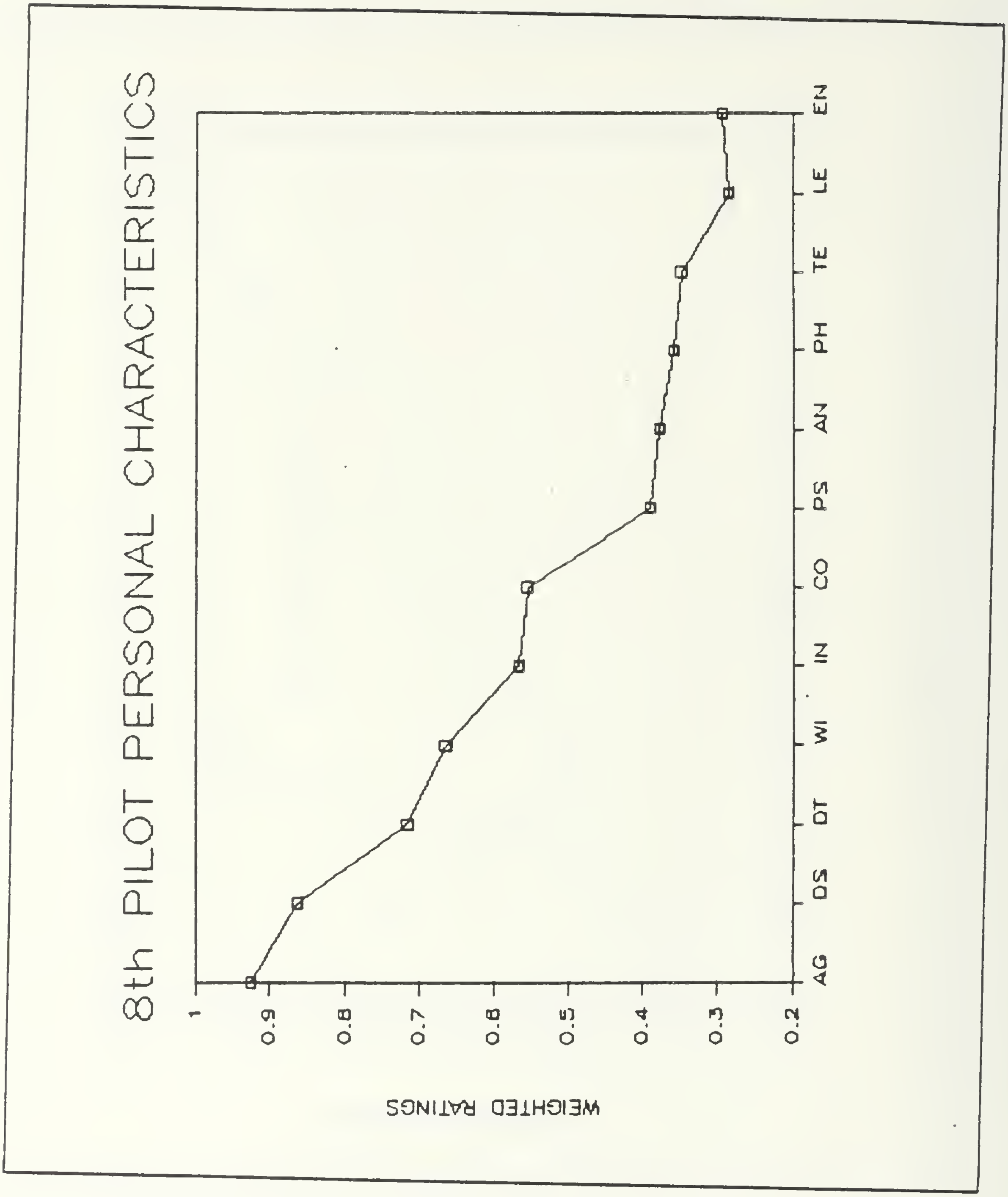


Figure E.20 Survey Results-Pilot 8.

9. PILOT 9

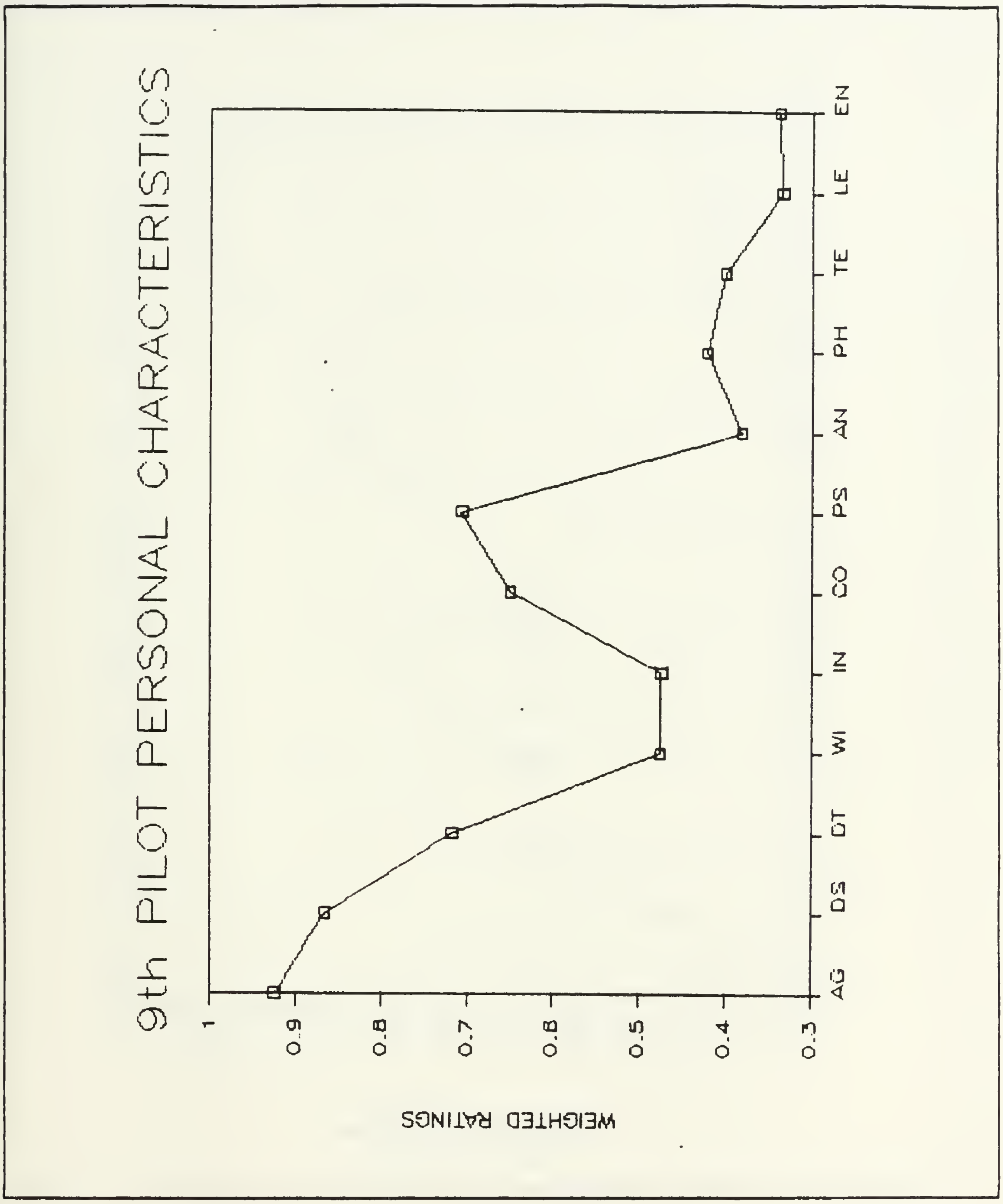


Figure E.21 Survey Results-Pilot 9.

10. PILOT 10

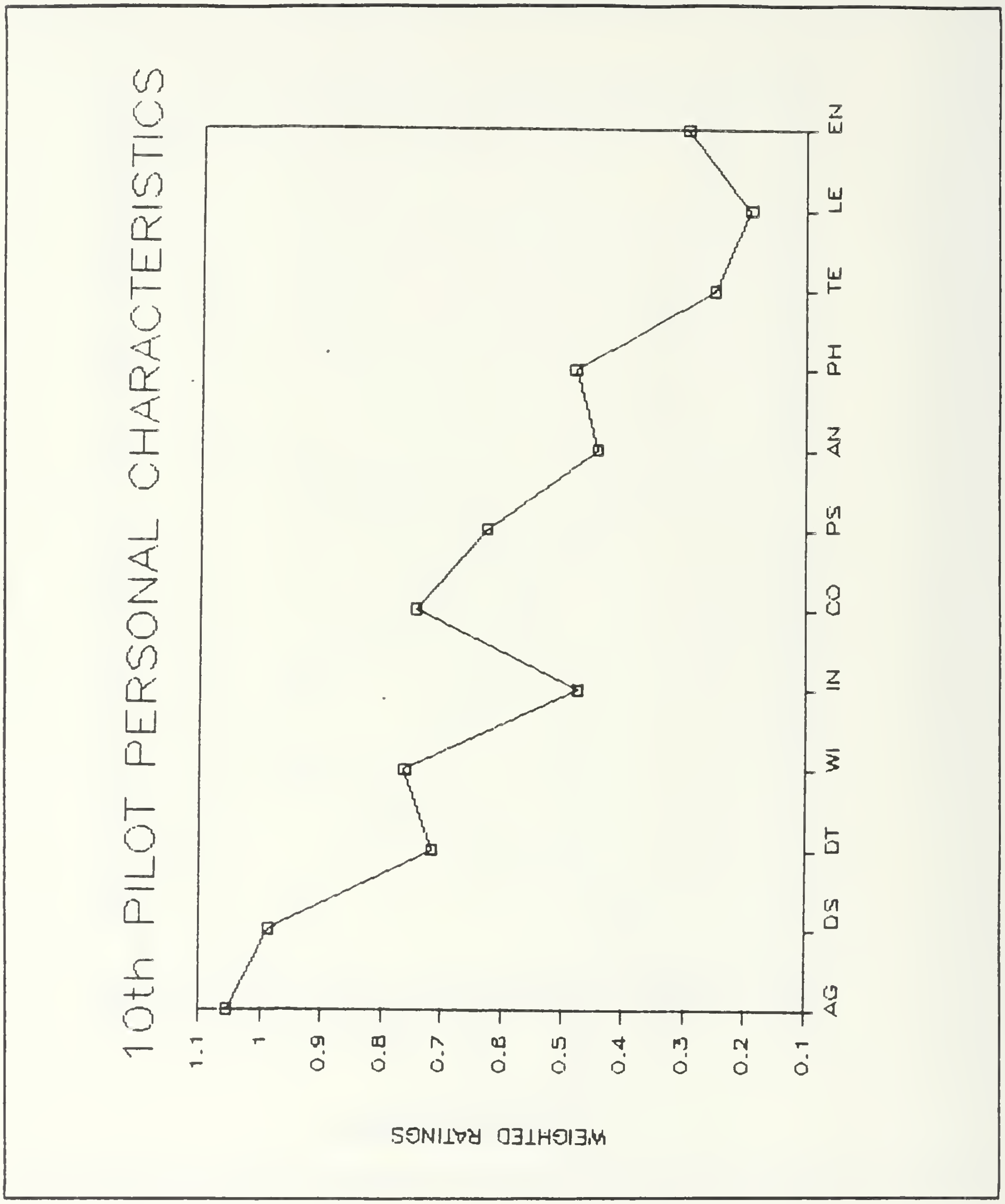


Figure E.22 Survey Results-Pilot 10.

11. PILOT 11

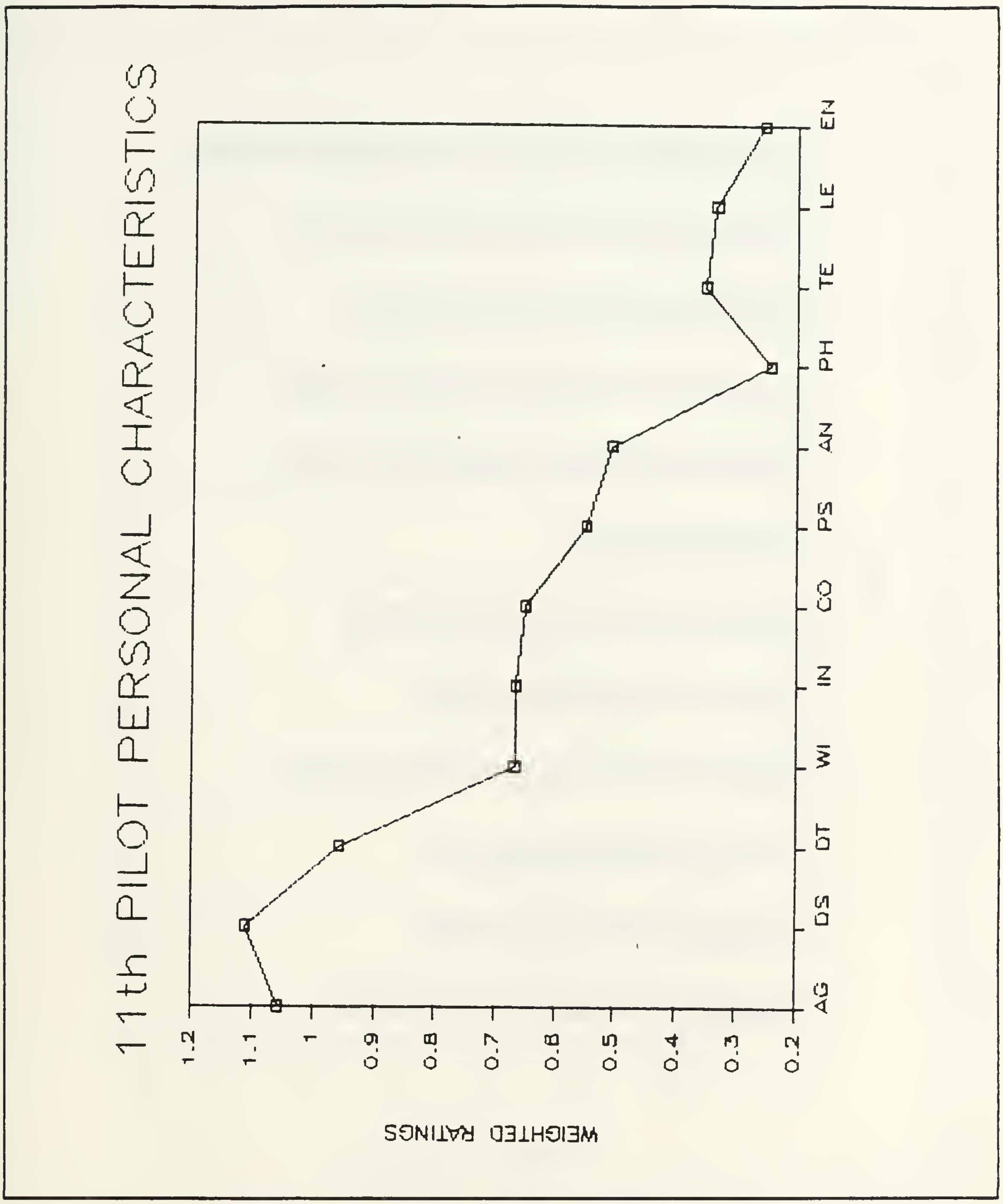


Figure E.23 Survey Results-Pilot 11.

12. PILOT 12

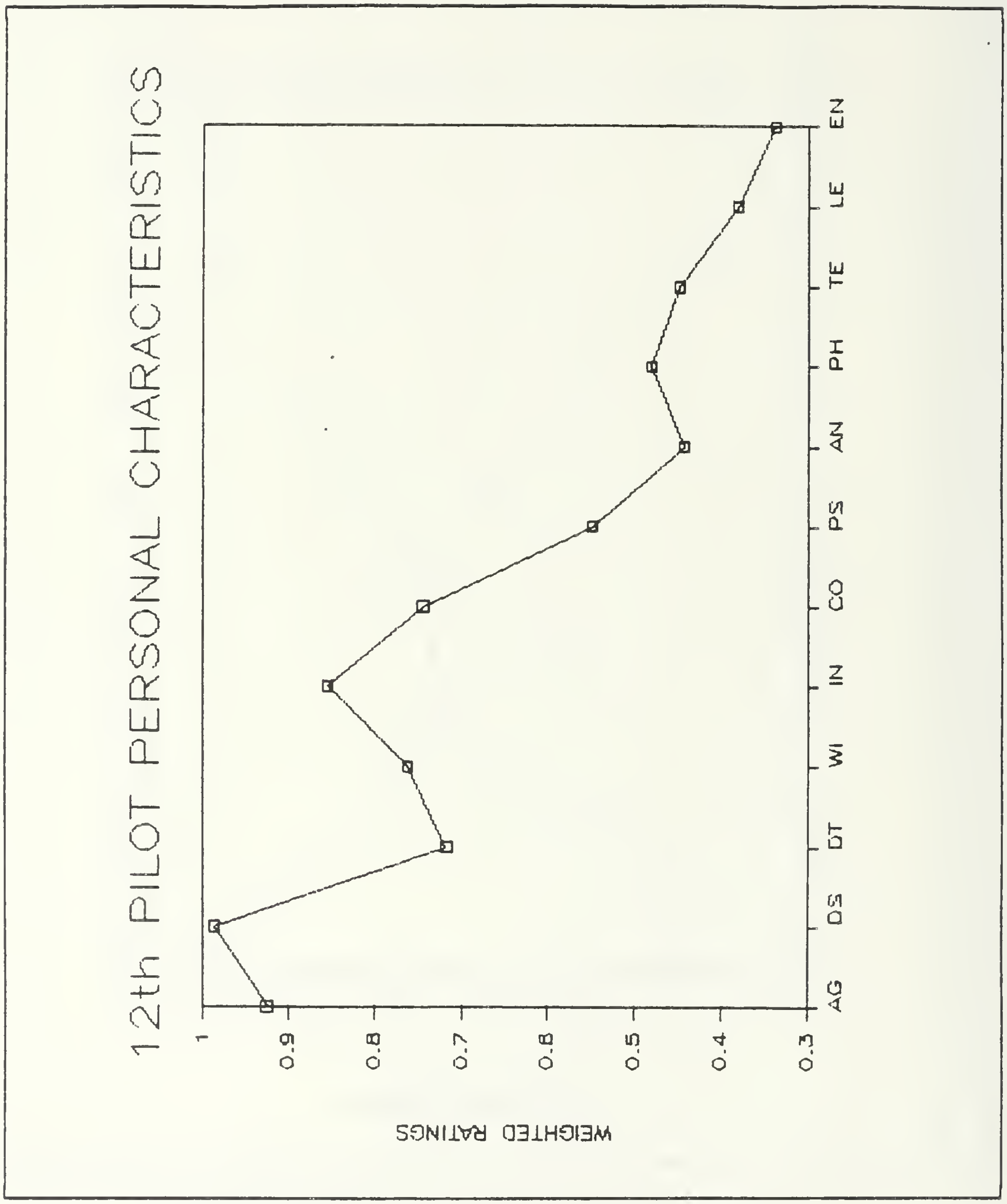


Figure E.24 Survey Results-Pilot 12.

5. SPECIAL COMBAT SKILLS ANALYSIS

1. Early Visual Target Acquisition

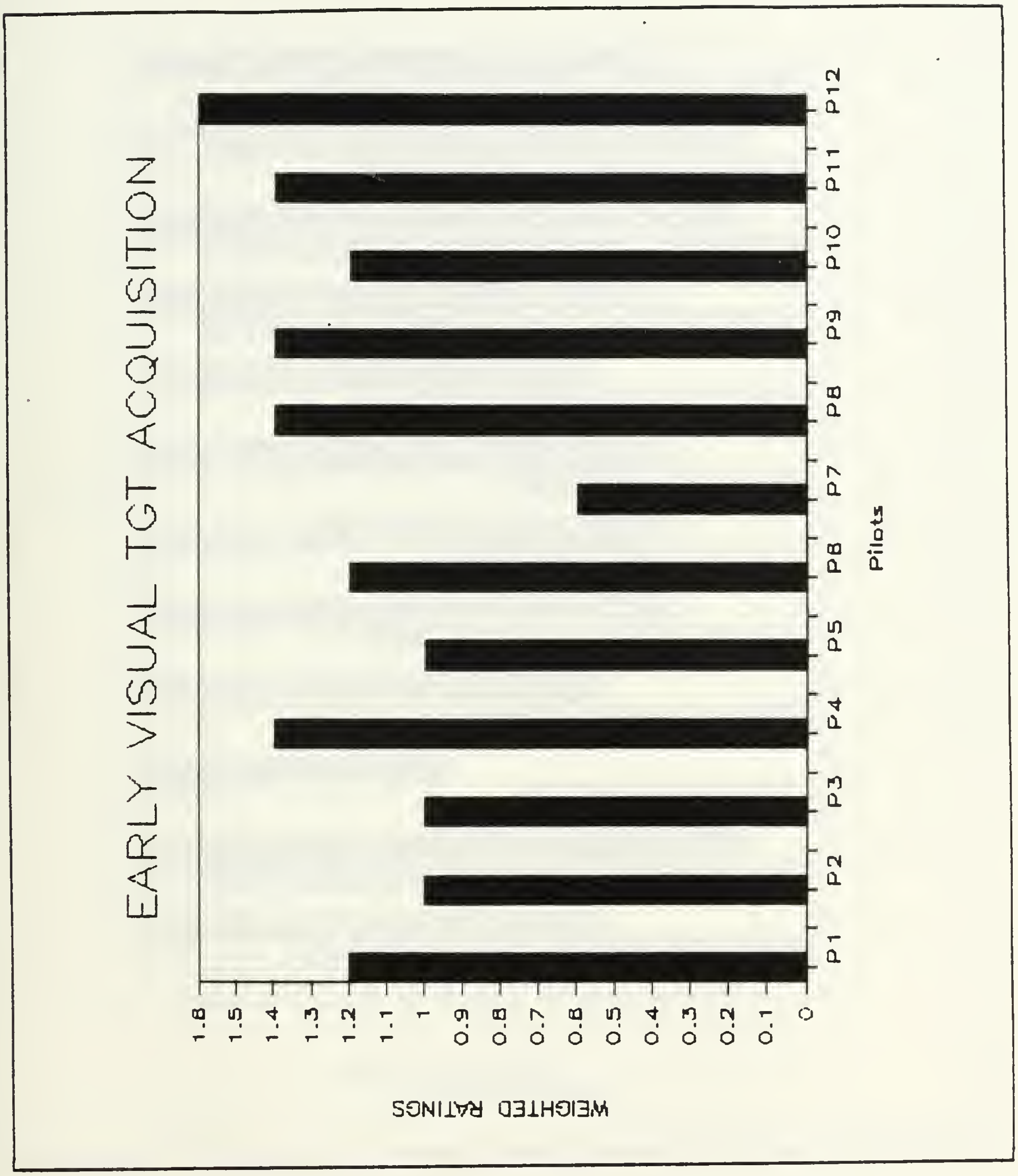


Figure E.25 Early Visual Target Acquisition.

2. <u>Select/Execute Best Maneuver</u>

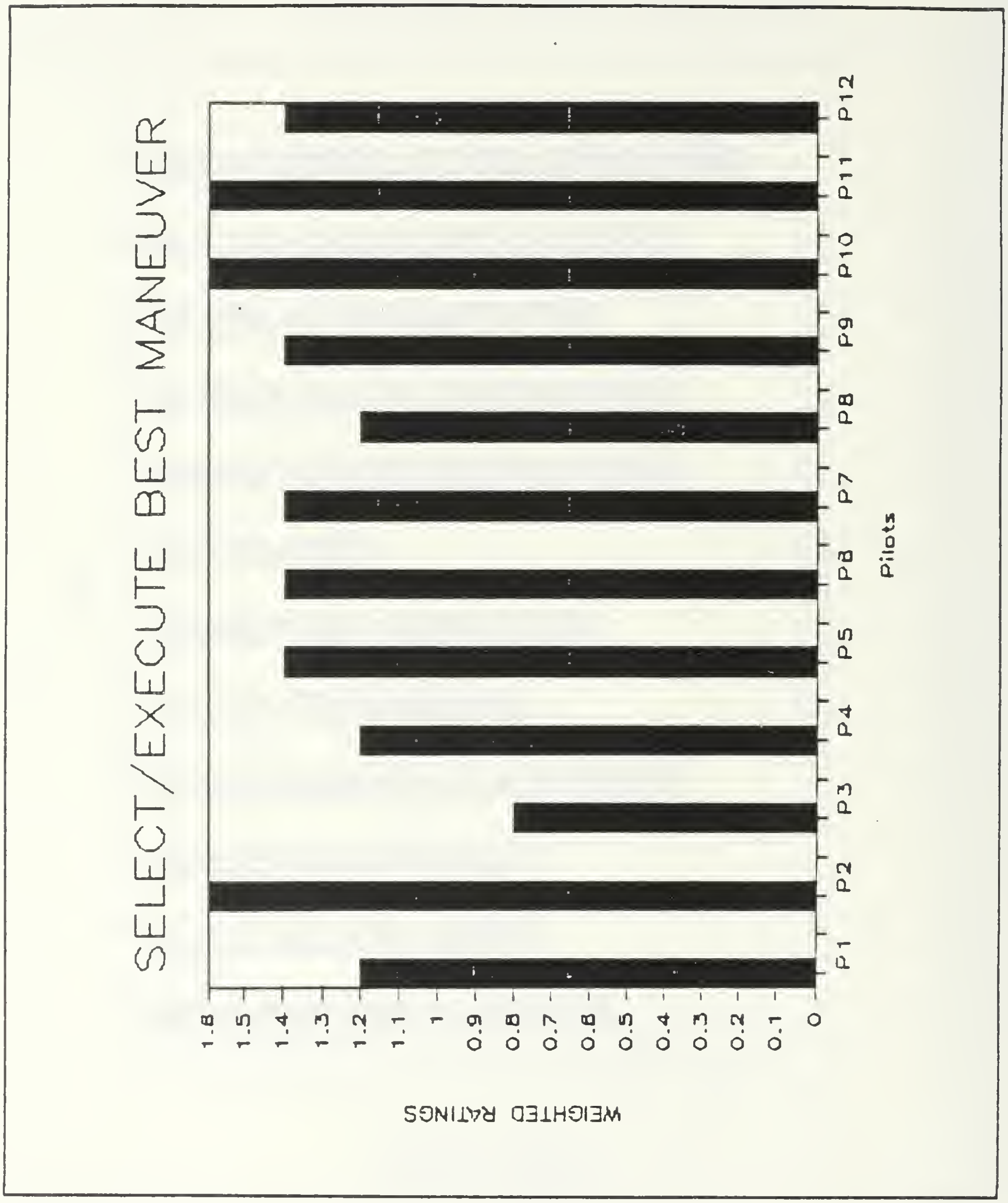


Figure E.24 Select/Execute Best Maneuver.

3. <u>Perceive/Judge Target Vector</u>

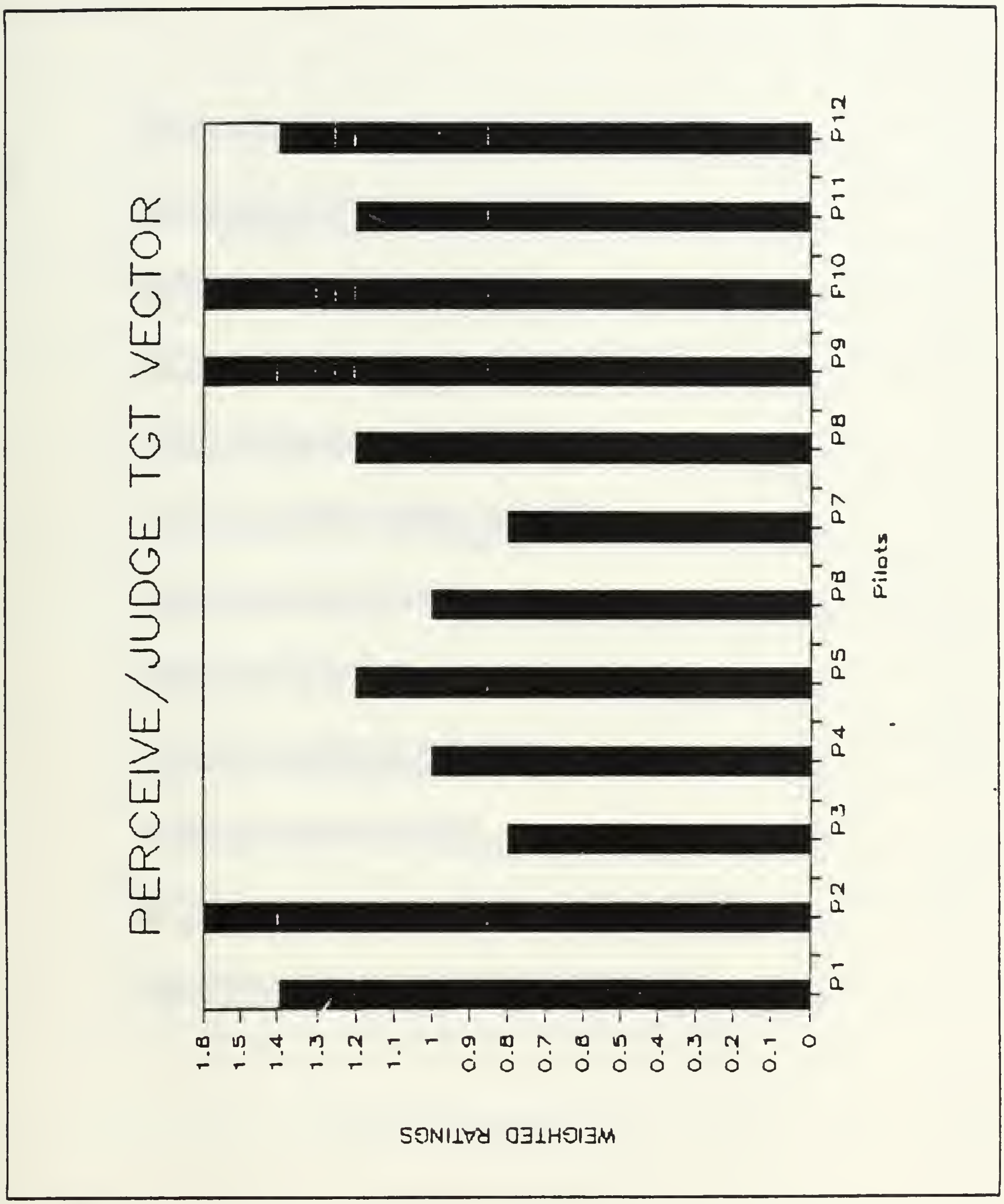


Figure E.25 Perceive/Judge Target vector.

4. Keep Track of the Other Aircraft

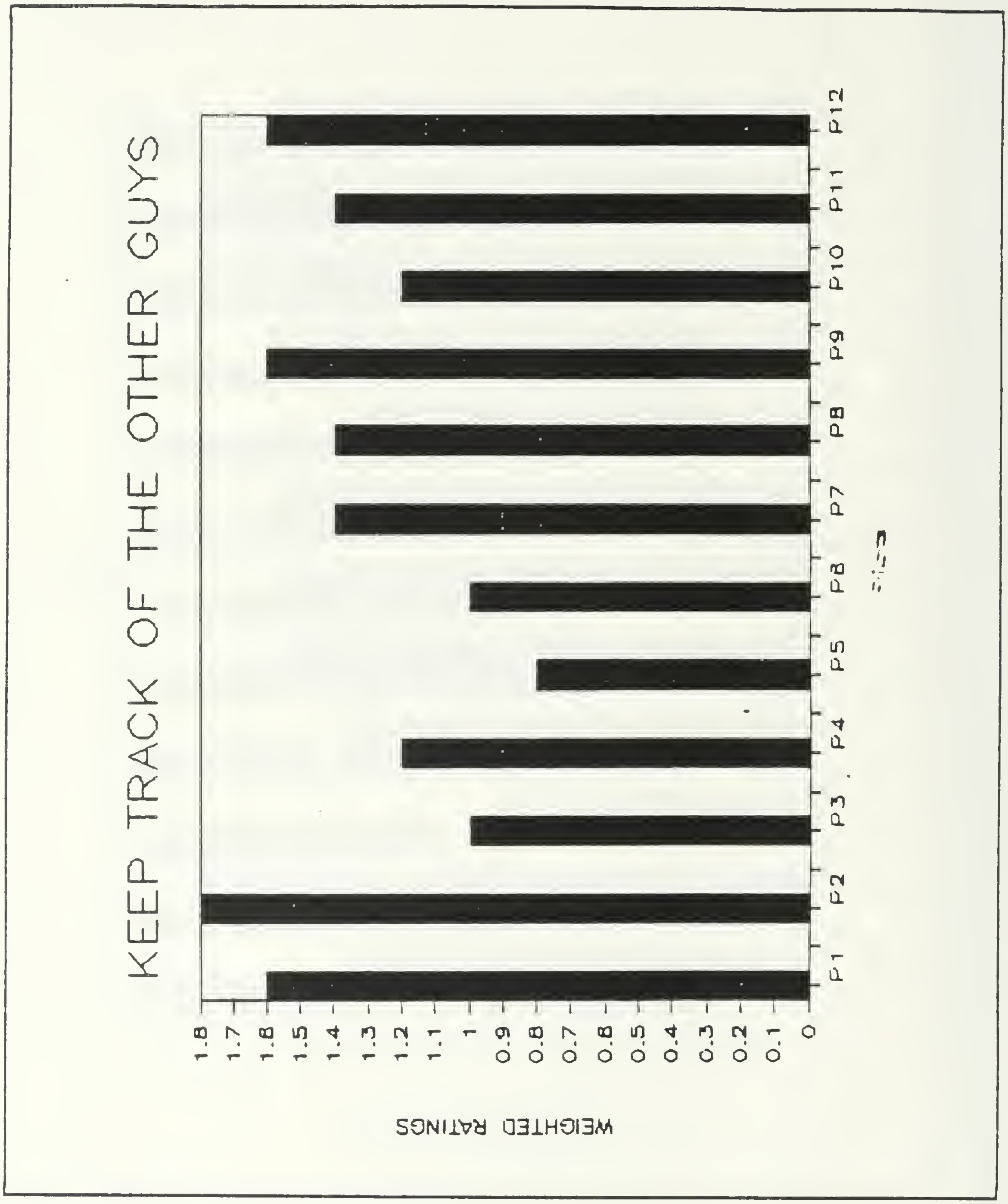


Figure E.24 Keep Track of the Other Aircraft.

5. <u>Judge when to Shoot</u>

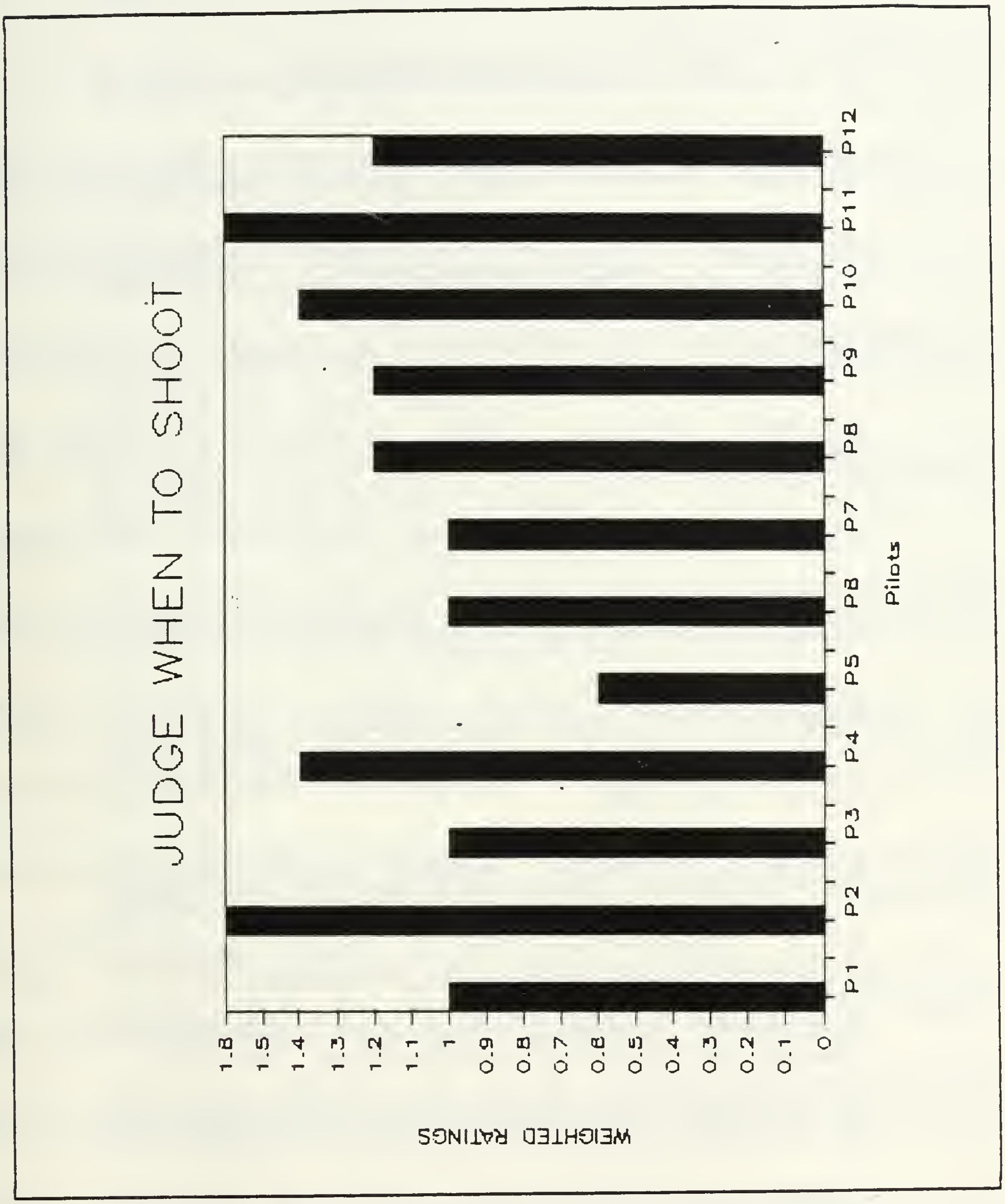


Figure E.24 Judge When to Shoot.

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